BLUETOOTH: Getting rid of cables!

SILICON CHIP

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PROJECTS TO BUILD - SERVICING - COMPUTERS - VINTAGE RADIO - AUTO ELECTRONICS

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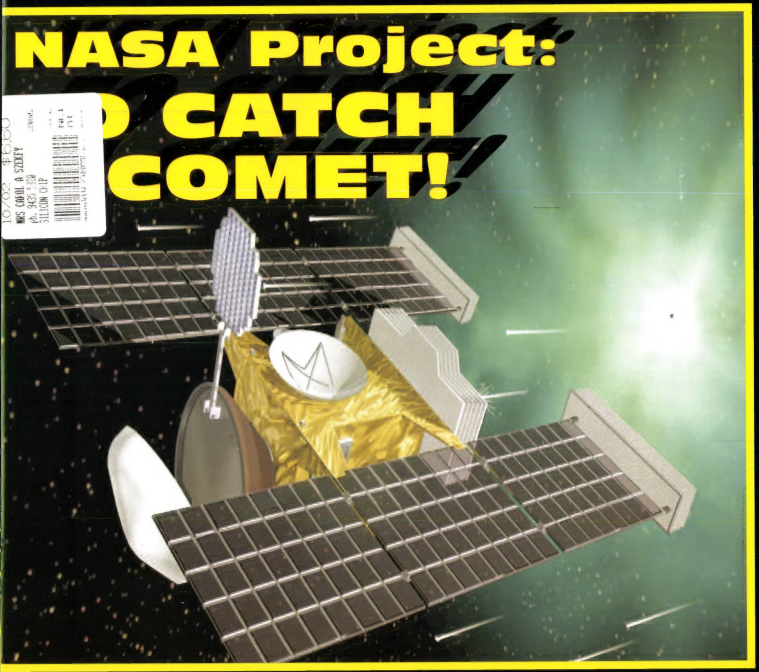
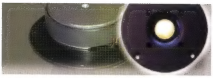


12V Inverter for 36W Fluoro Lamps

Hi-Fi Tweeters for Speaker Improvement, Building New Speakers, Home Theatre Systems & Speaker Repa

How This Astonishing, Mind Blowing Tweeter Can Instantly And Dramaticly Improve Your Speaker System, With A Ridiculously Simple Design Which Has Been Accidently Discovered By A Speaker Repairer.



Throw your fancy brand name tweeters in the rubbish. Greedy maufacturers have deceived everyones listening perception, so bad that you think you need expensive speakers, cables, cross-overs, etc.... To finally get the accurate sound you want and discover the true secret thats been right under your nose the whole time, keep on reading....

My name is Boyd and I've been fixing speakers for 18 years now, long enough to learn the difference between bad and great sounding speakers. Let me explain, for your knowledge, about different types of tweeters.

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- Silk Dome Tweeters;
Commonly used in expensive speaker boxes. They are incredibly dull, giving the impression of smooth sound, but the truth is.... they have no energy, they sound muffled and instruments like symbols are very un-defined.

- Plastic Dome Tweeters;
Are common in cheap speaker systems. They have energy but they are very harsh and have uneven frequency response.

- Metal/Titanium Tweeters;
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- Kevlar Dome Tweeter;
This material has incredible energy, very smooth and instruments like symbols sound

extremely detailed and live. Kevlar has natural sound and is very pleasant to listen to

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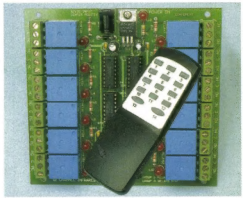

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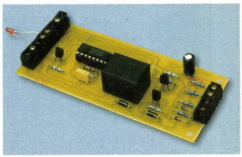

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PUBLISHER'S LETTER

The change to nanofarads

This month readers will notice a small but significant change to our circuit diagrams. Instead of capacitors being labelled in values such as .015μF and 0.1μF, they are now labelled as 15nF and 100nF. A number of readers have taken us to task in the past for not making this change years ago and now they should be happy.

Not that we have made the change to make those people happy. It is more to keep the circuits in line with the labelling actually being used on capacitors. For some time we have been including a conversion table to show the equivalence between specified values and the two codes most frequently used: EIA (Electrical Industry Association) and IEC (International Electrotechnical Commission). Now the values we will be using for capacitor values will be very similar to IEC labelling. For example, a capacitor labelled as 10nF will be labelled "10n".

To those unsure of the change, one nanofarad is the same as 1000 picofarads (1000pF) or .001μF. Similarly, 10nF is equivalent to .01μF and 100nF is the same as 0.1μF. Values of 1μF and above will still be labelled in "μF" and values less than 1nF (1000pF) will be labelled in "pF". To help with the change, we will continue to give the equivalent capacitance values (in brackets) in the parts list and we will also include them in the conversion table in project articles.

Up to now we have resisted making this change because we have felt that it was one more hurdle for beginners (and the old-timers) to deal with. But now that so many of the MKT (block) style capacitors use IEC labelling, we felt that it was appropriate to make the change.

Mouses should have keyboard equivalents

For years now, I have hated using a computer mouse. I would much rather use control keys or function keys to move around the screen and select functions. Call me an old fogey if you like but now it has been proven to be better for you. It seems that protracted use of the mouse leads to poor posture, neck and back strain and related problems. The recommendation now is that you should at least swap the mouse over to your left hand for periods during the day, to give your right arm a rest. But better still is to use control keys wherever you can.

I must also admit that part of the reason that I don't like using a mouse is that I have fairly large hands and therefore I find that the mouse, even larger ones, is awkward to use, particularly when "double-clicking".

Apart from that, I find it much faster to use Ctrl or Alt keys. In many programs you can do virtually everything without having to touch the mouse.

Drop down menus are great for complex programs but given the choice between a keystroke and a mouse command, I will use the control key every time. Unfortunately, in many programs there are lots of functions which cannot be called up by keystrokes – you are forced to use the mouse. But now that excessive mouse use has been shown to be undesirable, maybe software designers will give more thought to this aspect and provide their software with more control key functions for mouse actions.

Leo Simpson

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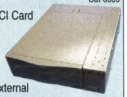

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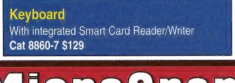

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MAILBAG

Good explanation of code hopping

The article on page 23 of the July 2002 issue of SILICON CHIP entitled "What is Code Hopping" is one of the best descriptions of rolling code chips that I have read so far.

I am an automotive locksmith, trying to inform other auto locksmiths, so this article will be very useful.

B. Williams,
Kogarah, NSW.

Table AM/FM radio sounds desirable

I've just been reading today's edition of "The Green Guide" in The Age newspaper. In it there is an advert and article about "the new Henry Kloss Model One AM/FM table radio". The article highly praises this radio and implies that plenty of them are being sold. It is quite an attractive looking radio in a wooden case and sells for $299. There are three styles of cabinet available.

It occurred to me that a similar radio may be able to be designed locally and offered as a kit at a (hopefully) lower price. The radio would need to be in a good-looking wooden case and with a decent output stage and speaker.

B. Freeman,
Morphett Vale, SA.

Comment: in practice, it would be very difficult for us to design such a project at a price that would be viable. However, there is another approach and that is to build a standard 12V car AM/FM radio/tape player into a timber case together with two speakers and a suitable power supply. Such a radio will give very good performance and is bound to be much cheaper than $299. We showed how to do this in our very first issue, November 1987.

XYZ table project wanted

Has the "XYZ Table with Stepper Motor Control" project described in the May to October 1999 issues of SILICON CHIP ever been available as a complete kit, short form kit or fully built up from any supplier? Perhaps there is a complete project or an unfinished one gathering dust in someone's shed or workshop. If so, I would be interested in purchasing one.

Andrew Court, 93 Norana Rd,
Upper Hutt, NZ.
email: ajcourt@ihug.co.nz

Passive preamplifier works well

I'd just like to offer my sincere thanks to Sam Yoshioka for his excellent phono preamplifier with passive equalisation design, as published in the July 2002 edition of SILICON CHIP. I have built the preamp and I find its performance *is* absolutely superb. I find it quiet, open and utterly musical. My LPs have never sounded better.

By the way, can anyone tell me why record scratches, clicks and pops are now not so obvious? And it's not due to high frequency roll-off either.

I have always had a belief in the musical virtues of passive equalisation over the more common op amp feedback loop arrangement and I believe that the open, unstressed sound of Sam's design reflects this. A highly recommended circuit.

Felix Scerri,
Ingham, Qld.

Solar tower of power

What an interesting article in the July SILICON CHIP, "Solar Tower of Power" by Sammy Isreb. For Australia, with lots of sunshine and open space and with a peak load in summer, this is perfect. In New Zealand, where I live, the peak power use is in winter. I look forward to a possible follow-up article.

As a glider pilot from way back, I am aware that on a sunny day there is enough rising warm air from a dark-coloured ploughed paddock in an expanse of lighter-coloured growth to make your aircraft suddenly climb when you fly over it; ditto the large dark roofs of industrial buildings. So, I was wondering why the grass was left under the prototype solar tower in Manzanares, Spain (see photograph, July 2002, page 8) when presumably a layer of dark asphalt under the "greenhouse" would make the air hotter.

Perhaps better, why not have a huge concrete block painted matt-black covering the entire area enclosed by the greenhouse roof? (Big concrete blocks were used in the "nightstore" heaters of some years ago in NZ to retain heat from cheaper, off-peak power). Then you wouldn't need to use water as proposed in the article to even out the day/night power generation curve of the solar tower and concrete can't "leak out" and won't corrode its self-provided "container" (the ground).

Don't get me wrong, I think the solar tower idea is an elegant idea as it stands. As the article says, the Solar Tower technology is just "a step" in the right direction and I hope it happens.

Stan Hood,
Christchurch, NZ.

Suggestions for projects

I recently rekindled my appreciation of electronics and started buying SILICON CHIP magazine again. Some of the projects are great; eg, the camera in the drain pipe, however some are mediocre. As I have been out of the game for a while, I am a bit hesitant to tackle some ideas I have for projects. May I suggest the following ideas:

(1) An overvoltage and/or over temperature and surge protection circuit for the supply rails of PC power supplies (mostly now made in China, where quality control seems to be non-existent).

I have noticed in my work several times a year that I need to replace customer PC power supplies. Usually,

the capacitors blow themselves to bits and occasionally a dangerously higher than expected voltage appears on the 5V and 12V rails, thereby taking out the motherboard, CPU, HDD, etc. One faulty capacitor takes out the whole PC!

(2) An over-temperature monitor for laptop PCs. I have come across more than one instance where the fan bearings dry up, the CPU and surrounding motherboard get cooked, and the laptop is useless. The repair cost for these replacement components is prohibitive and what was once a good laptop is now on the scrap heap. You have one disappointed customer who can't understand how an $8 fan can ruin a $4000 laptop!

(3) A piezo/strain/weight gauge for use in weighing your horse float, trailer, builder's ute, etc (one wheel at a time). You could take it with you to the soil/gravel/landscaper's yard and check your weight before you drive home. The road authorities are now pretty strict on what your vehicle can carry and there are many instances where people just haven't got the foggiest idea of how much weight they are carrying on or behind their vehicles.

(4) A degaussing wand for TVs and video monitors.

Shane Dwyer,
via email.

IR interference from compact fluorescent lamps

I just thought I'd drop you a line about what I found out after I built two kits. I initially built the MP3 Jukebox in the September & October 2001 issues (nice kit!) and found programming the keys a bit tricky, getting different codes if I held the remote button down too long. This was annoying but it still worked.

However, after I built the recent IR controller kit (SILICON CHIP, February 2002) to turn on 10 different appliances, I noted that the signal received LED was continually flashing. This was weird since to my knowledge, there was no other source of IR.

Then finally it dawned on me that the older TV and vacuum cleaner which both have IR controllers also operated in an intermittent manner. I turned off the compact fluorescent in the living room and everything worked perfectly. I turned on another compact fluorescent in the same room. No problem but once I turned on the original CFL, the IR received LED went "gaga" again.

Anyway, I thought you might be interested since I note that the "Ask Silicon Chip" in the July 2002 issue, the IR on the MP3 Jukebox was causing one of your readers a problem with the programming.

Steve Ballestrin,
via email.

Comment: thanks for the information. The topic of compact fluorescent interference with IR controllers has come up previously in SILICON CHIP but it is worthwhile to repeat the story. We think compact fluoros are diabolical devices anyway.

Digital TV decoder would be a good project

There's something that bugs me about paying about $900 for a digital set-top box, particularly when it's in a cheap-and-nasty plastic box and weighs next to nothing! I'd reckon that a project to build one would go like hot cakes in Australia. I was wondering if there are any plans afoot or anything being researched at the moment?

James Logan,
via email.

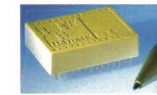
Comment: that box may be cheap and nasty in appearance but inside it is packed with a heap of LSI chips which cost squillions to develop. We don't think there will be a DIY set-top box anytime soon, if ever.

Extension software for MP3 controller

Over the past few months I have been reading letters regarding the MP3 remote control (see SILICON CHIP, September 2001) in particular, in relation to the Winamp plug-in and what it can and can't achieve. Recently I came across an excellent piece of software which allows the IR controller to control not only Winamp but any other program within the Windows environment, as well as system functions.

Using this software I am now using the project to control Winamp, WinDVD and Windows Media Player, all using the Aifa AV8E universal remote from Altronics. The software is

The Tiger comes to Australia



The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I^2C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

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Mailbag: continued

called Girder, is free for personal use and is available at **www.girder.nl**

In order to use the software with the MP3 controller, the generic serial device plug-in available at this site is required, with the COM port settings to be as prescribed by the original SILICON CHIP article. I also believe that with some driver changes explained on the web site, the PC Infrared Transceiver which featured in the December 2001 issue can also be used with this software, although I have not yet tested this.

Hopefully this information will be useful to you and to other builders of the IR kits.

Michael Green,
via email.

Remote control extender works with Mitsubishi VCRs

I have constructed one of your kits from Jaycar Electronics, the updated Remote Control Extender from the June 1996 issue. It works fine and I was impressed how you included everything I needed.

My issue is that while it worked fine on my NEC television and my spare Philips VCR, it did not seem to be compatible with my Mitsubishi HS-661V (hifi stereo) VCR which is the one I bought the kit for.

Having been informed by you that the project is not compatible with Mitsubishi TVs and VCRs, I persisted. I purchased an AR-1712 (basic 4-in-1 model) learning remote from Jaycar and it now gets through.

The learning remote generates a stronger response on the acknowledge LED than the original remote from the VCR. I am using light speaker wire instead of the figure-8 wire suggested and for adaptability I used an RCA panel-mount socket on the box and mounted the transmit LED inside and protruding from an in-line RCA socket.

I have the transmit LED positioned quite close to the VCR's receive port. More than one way to skin a cat!

Darren,
via email.

Comment: thanks for this tip. Quite a few readers have had this problem.

Fuel cell project would be good

I've really enjoyed the series of articles on fuel cells. It is really clarifying an area that I, and I suppose many other people, have had neither the time nor the resources to fully understand.

But while I now have some theoretical understanding of the principles, I still don't fully understand how to put it into practice. That is, how to actually make one!?

Have you thought of producing a fuel cell project? Say the alkaline fuel cell, seeing that it was the first to be used successfully, is used by NASA and seems to have so many plus points (I'm particularly impressed by the water by-product).

I can see such a project being used in schools as well. It doesn't have to be anything elaborate, just to demonstrate basic principles.

Jacob Westerhoff,
via email. **SC**

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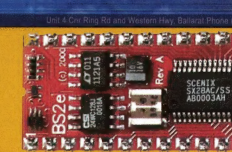

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☐ Yes, I'm interested in joining the buying mission to *Hong Kong Electronics Fair 2002 and/or *Hong Kong International Lighting Fair 2002. Please send me the information pack incorporating the registration form.

☐ No, I am not able to join on this occasion but please keep me informed of other buying missions to HK.

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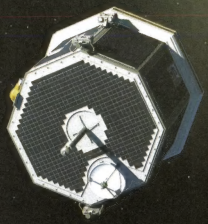


Imagine . . . a lone spacecraft hurtling through space, millions of kilometres from Earth. As its approaches a comet, its electronic systems awake from slumber and fire off an impactor module. Jam-packed with guidance and imaging systems, this projectile locks on to its target, hurtling towards imminent collision. In the final moments before its destruction, the spacecraft beams crucial photometry back to Earth and then rips a massive crater into the comet

By SAMMY ISREB

HIT A COMET

No, this isn't the plot of a Hollywood blockbuster. It's the goal in a series of three NASA missions to study comets within our Solar System.

For thousands of years man as been fascinated by the phenomenon of comets. Up until a few centuries ago, the sight of the bright halo-like streaks across the night skies brought with it a sense of awe, for an apparently heavenly body. As science evolved, an understanding developed that comets were merely rocky projectiles, be it beautiful ones, hurtling through the vastness of space, propelled and guided by gravitational forces.

As astronomical techniques advanced, scientists were able to view comets in detail and they have developed the hypothesis that comets have a composition of ice and dust, probably around a rocky core. This hypothesis should be proved (or not) by a series of spacecrafts being launched by NASA.

In January 1999, NASA launched the first of this series of spacecraft, Stardust, and this has just been followed on July 3rd, 2002, by CONTOUR (Comet Nucleus Tour). See www.contour2002.org

The final craft, Deep Impact, is set for launch in January 2004.

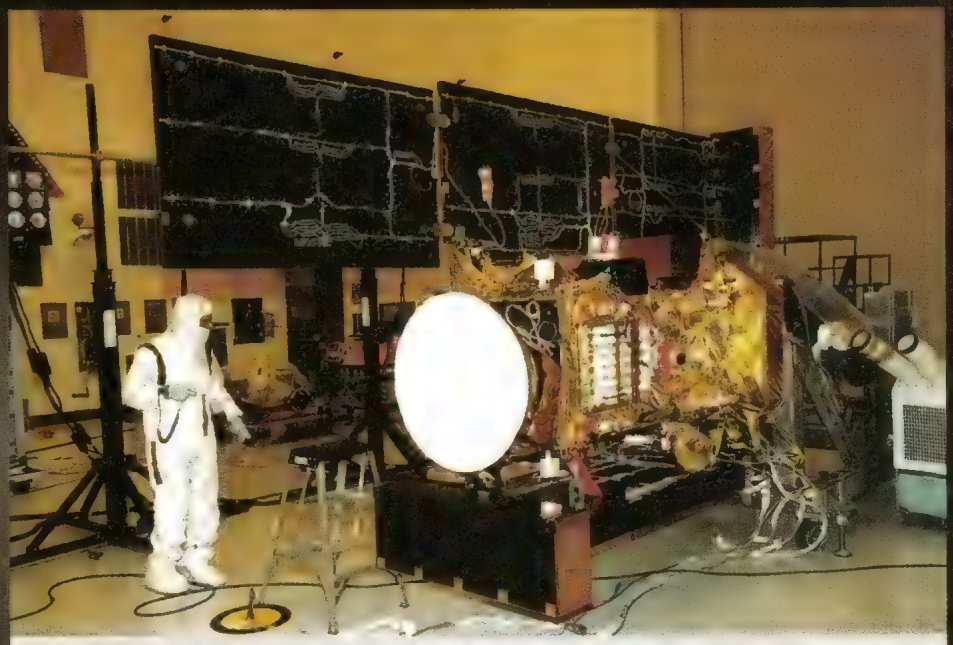
The Stardust Mission

The Stardust craft, launched in January 1999, has already clocked up an astounding 2,263 billion kilometres towards its January 2004 rendezvous with the comet Wild 2. This periodic comet had its orbit deflected somewhat closer to the sun following a near collision with Jupiter in 1974. As Wild 2 is distinctly smaller than comet Halley and orbits further from the sun, it lacks the signature tail of Halley, instead exhibiting a dull glow when observed from Earth.

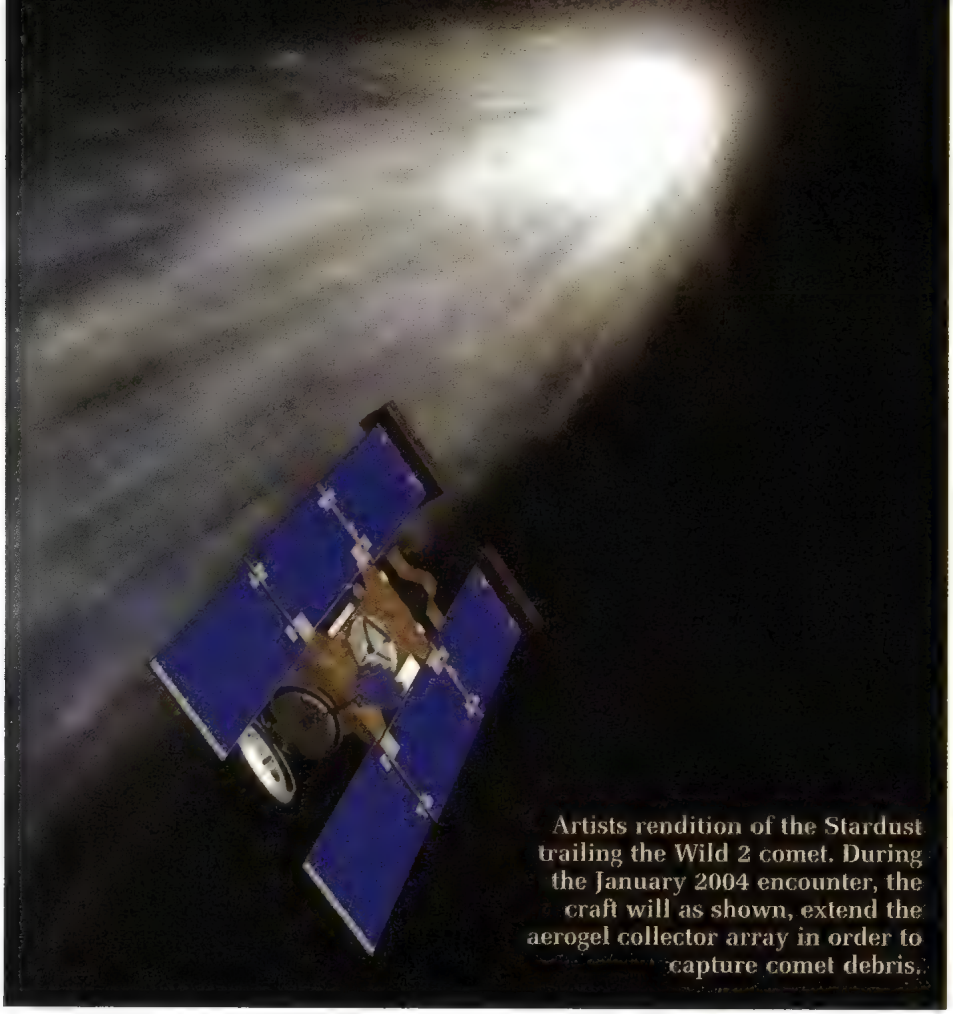
When a comet passes by the sun and is heated, sublimation effectively boils off material to produce the coma, the gaseous halo around the core. With each periodic fly-by of the sun, more and more of this volatile material is boiled off, eventually leading to an inactive comet, devoid of a coma. As Wild 2 has only recently commenced flying by the sun since its orbit alteration several decades ago, it is an ideal choice for study due to its high level of volatility.

With each fly-by of the sun, Wild 2 will throw off fresh core material. It is this fresh material which is of special interest to the Stardust mission, which aims to catch a small quantity of these particles before returning them to Earth for analysis. This will be a world first, giving scientists detailed information on the composition of comets.

Along with the actual 'capture' of particles, scheduled to take place during January 2004, the Stardust craft is configured for a rendezvous period commencing 100 days prior to and concluding up to 150 days after this



In the Payload Hazardous Servicing Facility, a worker looks over the solar panels of the Stardust spacecraft before it undergoes lighting tests.



Artists rendition of the Stardust trailing the Wild 2 comet. During the January 2004 encounter, the craft will as shown, extend the aerogel collector array in order to capture comet debris.

date. During this extended window additional data in the form of photometry across many spectral bands will be acquired and transmitted to Earth.

Around six hours before Stardust reaches the closest approach to Wild 2 (100km from the sunlight side of the comet), the dust collector containing Aerogel material will be deployed. The craft will then manoeuvre to align both its dust shield and the collector array, perpendicular to the dust stream.

By then, Stardust will be moving at a velocity of 6.1km/s, relative to Wild 2. At this speed the Aerogel material will best capture the dust ejected from the comet, ranging in size from one to 100 microns.

Two years later, in January 2006, Stardust will be in the final stages of the Earth Approach Subphase. At this time the Sample Return Capsule (SRC), containing the retracted Aerogel collector array, will detach from the main craft. The Stardust craft, mi-

As Stardust slingshots back into space, the ejected SRC module will hurtle towards Earth, 125km above the surface and travelling at 12.8km/s (ie, 46000 kilometres/hour!).

As the SRC descends through the atmosphere, a protective thermal shell will absorb 99% of the capsule's kinetic energy and protect the sensitive internals from the immense heat. At 3km above the landing site in Utah, the SRC will deploy its internal parachute, guiding the comet dust payload back to Earth.

Aerogel Capture Medium

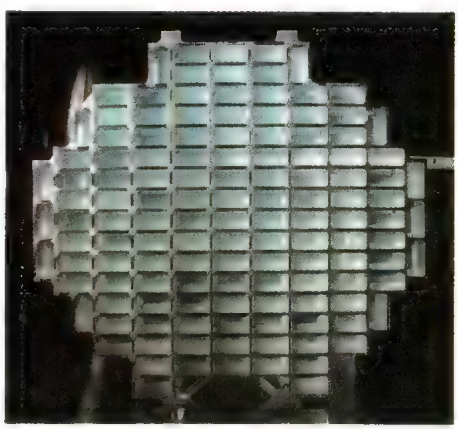
With the primary mission of Stardust being to capture dust particles from Wild 2, the Aerogel capture material is one of the most important parts of the craft. Travelling at up to 12.8km/s, the particles possess huge kinetic energy. The aerogel material must strip this energy from the particles without allowing them to alter their composition by being heated or pulverized.

Aerogel is a silicon-based porous, sponge-like structure, with 99.8% of its volume being air space. Although made from silica, aerogel is less than 1/1000th the density of glass, making it one of the world's lightest solids. The large amounts of air in the aerogel are used to provide a cushioning effect, so when a particle hits the surface it buries itself in the aerogel, creating a long track up to 200 times the length of the particle. This allows the particle to slow down and prevents it from altering in physical or chemical composition. Back on Earth, scientists will remove the dust particles from the aerogel for extensive analysis.

Stardust technical specs

Weighing in at 380kg including pro-

(Left): Though with a ghostly appearance like an hologram, aerogel is very solid. It feels like hard styrofoam to the touch.



(Right): A close-up of the collector array, fitted with the aerogel collection media. This array will eventually return the collected sample to earth.

pellant, the 1.7m long craft was developed by NASA and Lockheed Martin Astronautics. The craft's payload consists of various scientific instruments. Along with the Aerogel Sample Collectors, other instruments are onboard are:

* **Comet and Interstellar Dust Analyser (CIDA)**: A real-time mass spectrometer to determine the composition of individual dust grains as they collide with a silver plate during flight.

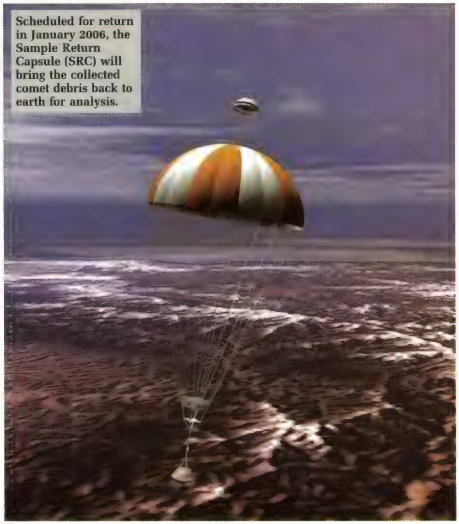
* **Navigational Camera:** In addition to acquiring high resolution images of Wild 2, to be transmitted back to Earth, this camera is used to navigate towards the Wild 2 nucleus during the dust capture portion of the mission.

* **Dust Flux Monitor (DFM)**: Mounted in front of the protective shield, the DFM unit gathers data on the density, distribution and direction of particles passing the craft.

The Aerogel Sample Collectors are integrated into the Sample Return Capsule (SRC), an advanced blunt body re-entry capsule, with parachute and mortar assembly.

The propulsion system of Stardust consists of a small amount of hydrazine (N_2H_4) propellant. Most of its ultimate velocity will be derived by planetary fly-bys.

Electrical power is generated by 6.6 square metres of solar panels, along with a 16 amp-hour nickel hydrogen backup battery. Data and communication systems use a 32-bit embedded CPU with 128Mb of memory. Acquired data is temporarily stored in this memory, before being transmitted back to Earth via the Deep Space Network X-band up/down link.



Scheduled for return in January 2006, the Sample Return Capsule (SRC) will bring the collected comet debris back to earth for analysis.

The aerogel material is super strong! A 2.5kg brick is supported on top of a piece of aerogel weighing only 2 grams.

All of the Stardust subsystems are built around an aluminum honeycomb core frame, surrounded by panels of graphite fibres encapsulated in polycyanate material. The front of the craft uses a "Whipple Shield" made up of several advanced materials, including ceramic blankets.

CONTOUR Mission

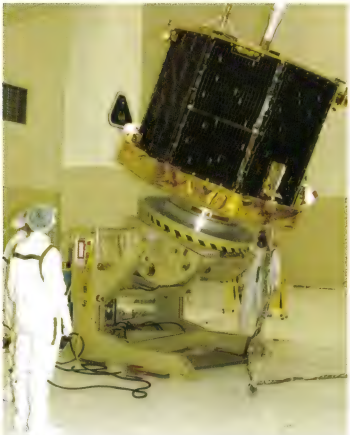
CONTOUR (Comet Nucleus Tour), launched on July 3rd, 2002, is the second mission of the series. The 4-year mission includes a meeting with comet Enke on the 12th November 2003, followed by a fly-by of comet Schwassmann-Wachmann 3, on the 19th June 2006.

Comet Enke is one of the most easily observable comets from Earth, having orbited the sun thousands of times over its life. Due to its 'old' nature, Enke gives off little dust and gas, which have boiled off long ago. This will give CONTOUR excellent visibility on the approach to its nucleus, with little risk of being bombarded by a high density of particles, which would be present in a more active comet.

Discovered only 70 years ago, comet Schwassmann-Wachmann 3, has since split into several pieces. CONTOUR will fly within 100km of these pieces.

Contour technical specs

The eight-sided CONTOUR craft measures 1.8m in height and 2.1m in width, and weighs 970kg. 503kg are the rocket motor, with another 80kg of hydrazine fuel. Electrical power comes from nine Gallium Arsenide solar panels, feeding nickel cadmium backup batteries. It has dual 5-Gigabit



(Above): The Comet Nucleus Tour (CONTOUR) spacecraft on display in the Spacecraft Assembly and Encapsulation Facility right before being assembled onto the launch vehicle.

solid state recorders for data storage. When CONTOUR has passed the comet and has a clear radio path to Earth, the data will be transmitted to the Deep Space network on Earth.

CONTOUR uses four state-of-the-art instruments in order to obtain mission data, as well as providing navigational inputs to assist in steering the craft towards the comet targets:

CONTOUR Remote Imaging Spectrograph (CRISP): Supplied by the Applied Physics Laboratory at John Hopkins University, the CRISP unit is a high resolution camera, operating in both the visible and infrared spectral ranges. It weighs At 26.7kg. With the approach to the comet Enke reaching a velocity of 28.2km/s, the CRISP unit relies on advanced optoelectronics to produce high resolution images at these speeds.

Light wavelengths shorter than 800nm are separated via a beamsplitter towards a high resolution CCD camera. The imager contains a 10-position selectable filter wheel, with one clear and nine coloured filters. These coloured filters have central bandpass wavelengths ranging from 450nm to 770nm and are used for determining the geological composition of the surface being imaged.

Light wavelenghts longer than 800nm (infrared) are directed to the spectrometer portion of CRISP, where separation into 256 different infrared wavelengths from 800nm to 2500nm occurs. The result is measured by a mercury cadmium telluride detector, cooled to minus 183°C, to obtain a two-dimensional spectral map.

CONTOUR Forward Imager (CFI): This tiny 9.7kg instrument is a high sensitivity ultraviolet imaging apparatus, designed for use at a range greater than 2000km from the nucleus of the comet under investigation. CFI will be first used to locate the target comet, from a great distance, against a backdrop of stars. CFI will then take colour images of the nucleus of the comet and its distinguishing features such as gas and dust jets. Lastly, CFI will use narrow bandwidth filters, tuned to the unique emissive frequencies of dissociated water, carbon, and dust, to allow identification of the active nucleus elements.

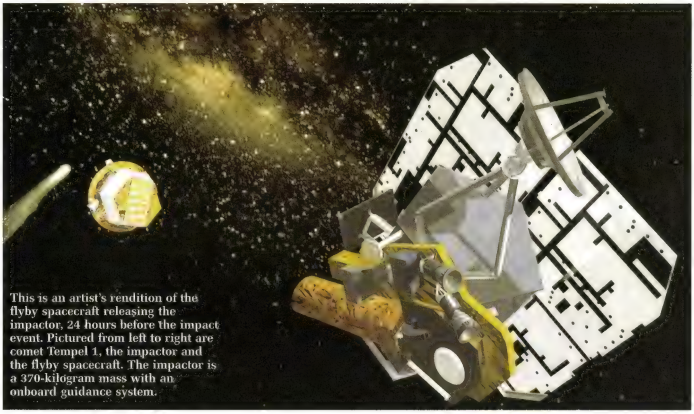
CONTOUR Neutral Gas and Ion Mass Spectrometer (NGIMS): The NGIMS instrument is a highly sensitive mass spectrometer, designed specifically to determine the composition of incident gas from within the coma. The 13.5kg apparatus will measure the relative abundance of water, methane, carbon dioxide, ammonia and hydrogen sulphide.

Comet Impact Dust Analyser (CIDA): Identical to the CIDA unit which has been launched on the Stardust mission, the 10.5kg CIDA instrument is used to determine the size and composition of inbound particles. In order to do this, as the dust particles fall upon a charged grid.

Depending on the size of the particles, a certain number of charged ions may be extracted by the charged grid. These then move through the instrument, past a reflector, and are measured by a special detector.

As there is a relationship between the size of the dust particle, and the time it takes for the proportionally sized ions it releases to travel through the apparatus, the CIDA can accurately infer the size of the incident dust particles.

(Below): The partially assembled Delta II rocket, containg the CONTOUR craft, was eventually launched into space on the 3rd of July 2002.



This is an artist's rendition of the flyby spacecraft releasing the impactor, 24 hours before the impact event. Pictured from left to right are comet Tempel 1, the impactor and the flyby spacecraft. The impactor is a 370-kilogram mass with an onboard guidance system.

Deep Impact Mission

The Deep Impact Mission is arguably one of the most amazing missions in NASA's history.

Reading like the plot of a science fiction movie, Deep Impact will be launched in January 2004 on board a Delta II rocket to make a rendezvous with Comet Tempel 1 in July 2005.

Around 24 hours before the encounter, Deep Impact will release a 370kg projectile equipped with electronic guidance and imaging equipment. It will send high resolution images right up to the moment when it crashes into the comet.

The impact is planned to (hopefully?) release core fragments, which will float towards the Deep Impact craft which will be trailing the comet. Also, after the impact fragments have been released, the fresh surface of core material in the crater will be visible to the Deep Impact craft.

Along with the impactor module, Deep Impact will carry three scientific instruments:

High Resolution Instrument (HRI): HRI is a high resolution telescope, with inbuilt infrared spectrometer. The resolving power of this instrument is so high, that from 700km away the HRI is able to image the comet with better than 2 metres per pixel resolution.

Following the impactor module's collision with the comet, the HRI will commence acquiring high resolution visual images, in addition to providing spectral analysis of the composition of the comet's nucleus. Around 300 megabytes of this data will be produced in the minutes following the collision.

Medium Resolution Instrument (MRI): The MRI serves as a backup for the HRI device, delivering a lower resolution of 10m at a distance of 700km in the visible spectrum. As the MRI has a wider field of view than the telescopic HRI, it is better suited to viewing the stars and navigating towards the comet in the days leading up to the approach.

Impactor Module

The impactor module is designed to separate from the fly-by spacecraft around 24 hours before it impacts into the comet Tempel 1. Weighing a mere 370kg, the impactor is intended to deliver 18 Gigajoules (roughly equivalent to 4.5 tonnes of TNT explosive) and is expected to blast a massive crater into the comet. In order to achieve this high energy collision, the impactor module will be travelling at 10.2 km/second (36720km/h) just before impact.

Given that the module will be released more than 800,000km from the comet which is only 6km in diameter, it is a complex task to ensure the impactor is on course.

To do this, a specially designed instrument, known as the Impactor Target Sensor (ITS), feeds data to autonavigation algorithms developed by the Jet Propulsion Laboratory, to make trajectory corrections via the small onboard hydrazine propulsion system.

After impact the fly-by craft will take visual images of the newly formed crater, as well as performing infrared spectroscopy analysis of the ejected material in order to determine the composition of the comet's nucleus.

The impactor module is made of 49% copper and 24% aluminum. These materials, not believed to be found within the comet, are used so that the analysis of the ejected material is not affected by the remains of the impactor module. **SC**

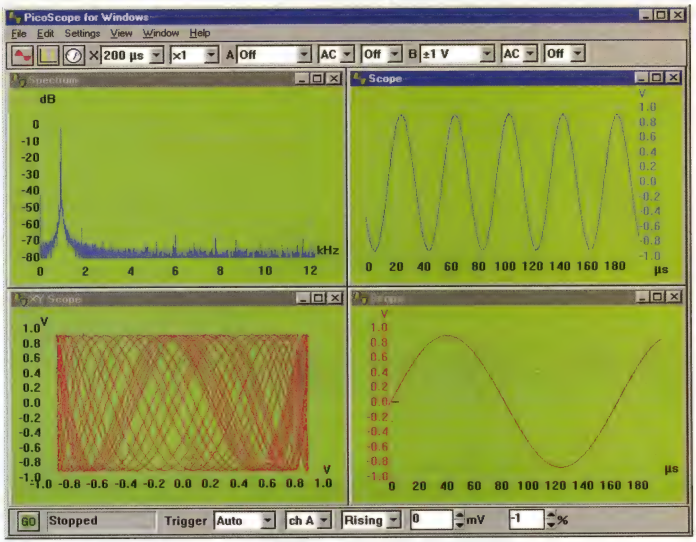
Acknowledgement:

Our thanks to NASA/JPL for their assistance with the details and photographs/illustrations for this article.

Perform fast & accurate signal measurement and recording in the workshop or on the go with this compact, fully-featured digital instrument.

pico ADC-212 Virtual Instrument

Review by Peter Smith



If you've recently purchased an oscilloscope or are in the process of doing so, you've undoubtedly noticed that the traditional analog models have gone the way of the dinosaur.

With ever increasing semiconductor performance, the digital oscilloscope can now do everything, and more, that its analog cousin can – for a lower price.

Digital storage oscilloscopes (DSOs) are not new, at least in the traditional stand-alone sense. Just like their analog counterparts, they include the usual front panel display and arrays of switches and knobs. In this format, they are typically very expensive pieces of test gear, often affordable only by top training institutions and R & D labs.

Companies like Pico Technology, a leading UK-based test equipment manufacturer, have changed all that by developing "virtual" PC-based digital instruments. By utilising the display capabilities and processing power of the PC, the hardware cost of the digital 'scope (or other digital instrument) can be reduced dramatically, while actually increasing functionality.

Of course, the "virtual" tag is simply hinting at the lack of the physical switches and knobs. Instead, measurements are displayed on a PC screen, with mouse clicks and menus replacing rotary dials.

We at SILICON CHIP still tend to prefer real switches and knobs in preference to the mouse and keyboard control that's part of all virtual instrumentation.

Having said that, the low-cost, portability and

ADC-212 Virtual Instrument specifications

Number of channels	2
Analog bandwidth	50MHz
Sampling rate	100MS/s (single channel); 50MS/s (dual channel)
Resolution	12 bit
Buffer size	128k words
Dynamic range	80dB
Voltage range	±50mV to ±20V in nine ranges
Overload protection	±100V
Scope timebase	10ns/div to 50s/div
Trigger modes	Free run, repeat, single
Input impedance	1MΩ
Input coupling	AC, DC
Accuracy	±1%
Power supply	12V DC 500mA (mains adapter supplied)
Interface	PC parallel port compatible output via D-25 connector
Dimensions:	190 x 140 x 45mm (L x W x H)
Software:	PicoScope, PicoLog & various drivers and examples

Pico ADC-212 Virtual Instrument

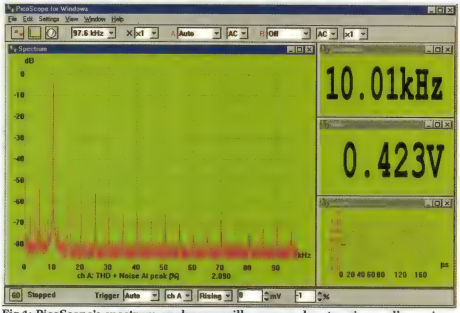


Fig.1: PicoScope's spectrum analyser, oscilloscope and meter views, all running simultaneously. Here we're measuring the noise and distortion from the SILICON CHIP Digital Sine/Square Generator. The generator is producing a sine wave at 10kHz (the peak), but note the smaller spikes. These harmonics originate in the digital circuitry and have passed through the generator's output filter network.

ever-increasing performance of virtual instruments simply cannot be ignored. Pico Technology's ADC-212 Virtual Instrument is a fine example of the functionality that can be included in a small package without it costing the earth.

Being PC-based, this product includes both hardware and software components. Let's look at the hardware component first.

Hardware

The ADC-212 is housed in a 190 x 140 x 45mm plastic (internally shielded) enclosure.

The unit hooks up to your PC via a free parallel port and the supplied one-metre cable. If you don't have a free parallel port, you can purchase an optional USB-to-parallel port adapter designed specifically for the task. Power is provided by a 12V DC 500mA plugpack adapter.

For portable use with a laptop PC, Pico Technology offers an optional 5-hour battery pack. The pack is supplied in a look-alike case and can be recharged in about 4 to 5 hours from the standard AC adapter.

The "front panel" consists of just three BNC connectors and a red LED. As this is a dual-channel instrument, two of the BNC connectors provide the 'A' and 'B' channel inputs. The third BNC can function either as a trigger input or signal generator output.

The digital signal generator produces a square wave with a selectable frequency of between 0 and 250kHz.

The hardware specifications are among the best that we've seen for a virtual instrument.

The analog bandwidth is quoted as 50MHz, with 100MS/s (million samples per second) possible in single-channel mode. In plain terms, this means that you can accurately measure frequencies to 50MHz, although in 'scope mode at this frequency, viewed waveforms will not be "true to life".

As with any digital 'scope, the incoming signals need to be sampled at between five and ten times their frequency for accurate on-screen representation.

For high sampling rates to be truly effective, a large storage buffer is mandatory. Obviously, the larger the buffer, the greater the portion of a signal that can be sampled at the maximum rate. A commonly employed method of dealing with limited buffer size is to reduce the sampling rate with each increase of the timebase setting. In the ADC-212, common sense prevailed and a large 128k sample buffer memory is standard fit.

In contrast with many DSOs on the market, the ADC-212 boasts 12-bit vertical resolution rather than the more common 8-bit. This pushes the dynamic range out to 80dB, with 1% basic DC accuracy.

As pointed out in Pico Technology's marketing blurb, 8-bit resolution can detect at best only 0.4% signal change.

This is no problem in digital electronics work, but in audio electronics, even 0.1% noise can be a disaster. 12-bit analog to digital (A-D) resolution and low front-end noise allows the ADC-212 to detect changes as small as 0.024% (244ppm).

The software

Pico Technology's virtual instrument software consists of two independent packages, called PicoScope and PicoLog. If your PC runs DOS or Windows (any version), then you should be able to successfully load and run the software.

Naturally, higher-performance PC hardware will result in smoother display updates, but Pico are confident that the DOS version will even run on that old 486DX2!

Note, however, that the DOS version does not include all of the functionality discussed below.

For custom applications, Pico have supplied drivers for DOS, Windows (16 & 32-bit) and Linux. Additional information, examples and various support files are included on the CD for C/C++, Pascal, Visual Basic, Delphi, LabVIEW, Testpoint, Agilent Vee and Excel.

PicoScope

PicoScope includes a digital oscilloscope, spectrum analyser and meter. All of these instruments can operate concurrently and with surprisingly little performance penalty.

All functions are controlled from within a single window (see Fig.1), which can be maximised to fill the entire screen if so desired. Buttons and drop-down menus along the top toolbar (the View bar) and the bottom

toolbar (the Sampling bar) provide quick access to all commonly used settings.

New oscilloscope, spectrum analyser, meter and X-Y oscilloscope windows (called "views") can be opened at any time.

In addition, up to four active views can be displayed in a single window (called "composite" view) in a variety of useful formats. For example, the "overlay" format renders the selected views transparent and overlays them for quick waveform comparison.

Window background, grid, text, ruler and trace colours can all be customised to taste. In addition, oscilloscope and spectrum analyser traces can be programmed to one of three possible widths.

Oscilloscope

By default, horizontal timebase settings range from 100ns/div to 50s/div. When ETS is enabled (see below), additional ranges of 10, 20 and 50ns/div are available.

Optionally, timebase settings can be displayed by X-axis period rather than by time per division. In this mode, timebase settings range from 100ns to 500s.

For detailed signal examination, the X-axis can be magnified up to 50 times in 1-2-5 steps. This is an indispensable feature when working with complex waveforms and large buffer sizes. A horizontal scroll bar appears when the magnified signal exceeds the display limits, allowing easy panning through the sample buffer to find the areas of interest.

As the timebase settings increase, it takes a proportionally longer time to fill the sample buffer and update the display. With this in mind, Pico have provided a "maximum samples" setting, allowing you to balance speed with sample size to suit measurement requirements.

Designed to eliminate noise from your measurements, another useful feature called "oversampling" averages a programmable number of samples (1 to 16) before updating the display.

The newest version of PicoScope (R5.08) includes a new feature dubbed "ETS" (Equivalent Time Sampling). In ETS mode, PicoScope oversamples the incoming signal to provide a higher overall effective rate – up to 5GS/s.

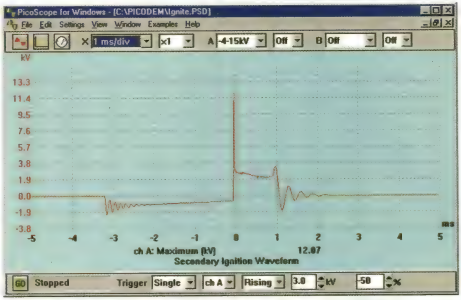


Fig.2: This view, borrowed from Pico's library of waveforms, shows the output of an inductive pickup sensing the secondary side of an ignition system. Note the markings along the horizontal axis, which indicate a -50% delayed trigger. Also note the vertical axis, which has been scaled up from mV (the sensor's output level) to read in kV.

In common with the averaging method described above, ETS is only suitable for repetitive waveforms. Maximum ETS oversampling rate and display update speeds are programmable in the Setup menu.

Vertical axis

Vertical settings range from ±50mv to ±20V in nine steps. An auto-range option is included to save repeatedly reaching for the mouse when you're probing your way through a circuit.

Another useful feature allows scaling of the Y-axis to match the attenuation of the probe in use. Available ranges are x1, x10, x20 and x100, covering all probe variants that you're likely to encounter. Now all you have to do is remember to change this setting whenever you slide the probe switch!

Like the horizontal axis, the Y-axis can be magnified at will via a drop-down menu on the View bar. Up to x10 magnification is supported, and once again scroll bars provide a means of viewing the entire signal excursion should it exceed the bounds of the display.

Custom ranges

If you're measuring the output of a sensor, then why not display the relevant units (°C, kilopascals, etc) on the vertical scale instead of volts? This is a must-have feature for documentation purposes, and it certainly eases the strain on the grey matter.

Any custom ranges that you define are automatically added to the available vertical range settings on the View bar. Fig. 2 shows how it works. Here, PicoScope is measuring the output of an inductive pickup attached to the secondary side of an automotive ignition system. Note the vertical scale – it's graduated in kilovolts (kV)!

Triggering

PicoScope includes comprehensive triggering capabilities, with most settings instantly accessible from the Sample bar.

In addition to the usual triggering modes ("auto", "repeat", "single" and "none"), the desired trigger threshold in millivolts can be entered directly. Alternatively, the trigger threshold and polarity can be set by

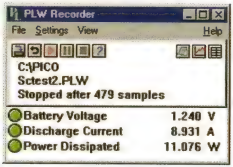


Fig.4: The Recorder view. We're logging the current and voltage from a (simulated) battery pack and using PicoLog's calculated parameter function to add "Power Dissipated".

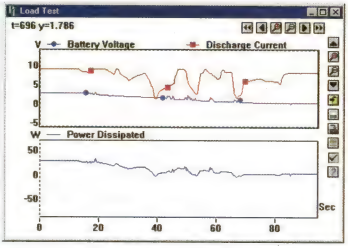


Fig.5: Zoom and scroll buttons make it easy to find what you want in Graph view.

clicking and dragging a little grey "bug" to the desired level.

A useful feature of DSOs is their ability to begin storing data at some time before or after the trigger condition is met. PicoScope calls this "trigger delay", and it's programmable on the Sample bar as a percentage of sweep time.

Easier still, you can drag the same "bug" (in a horizontal direction this time) to visually position the trigger point anywhere within the buffer.

The benefits of delayed triggering are clearly visible in Fig.2. By selecting a -50% trigger point, the rising edge of the discharge pulse is positioned in the middle of the buffer, allowing examination of the entire coil charge and discharge cycle.

Lastly, a "save on trigger" function is provided for trapping intermittent or random events. This function writes a copy of the sample buffer to disk every time the trigger condition is met. Each write to disk creates a separate file, reloadable later for waveform analysis and documentation.

Making measurements

Once you've got the signal "tuned in" the way you want, you can apply one or more of a whole host of measurements. The simplest measurement involves clicking and dragging horizontal and vertical cursors to the desired positions and reading off the computed voltage levels and times.

For more challenging work, PicoScope includes 19 automatic measurements. These include frequency, high pulse width, low pulse width, duty cycle, cycle time, DC voltage, AC voltage, minimum, maximum, risetime, falltime, and voltage and time at the cursor positions.

In addition, a range of statistical functions can be applied across all measurements, including average, standard deviation, minimum, maximum and pass/fail.

Naturally, you can define the upper and lower limits for the pass/fail function, which includes the ability to display an alert message and save the buffer to disk when either limit it exceeded.

Measurements can be made over the entire buffer or in relation to the set cursor positions. To include any of these measurements at the foot of a Scope view, you simply add them to a measurement list. Separate measurement lists can be defined for each active view, too.

Exporting measurements

Measurements are updated in real time, so providing a "snapshot" of each sweep. However, there is often a requirement to analyse measurements over time to discover signal trends, abnormalities, etc. Commonly, a second application, such as Excel or MathCAD, would be used for the data analysis.

PicoScope provides an easy method of exporting data to other applications. Data from the active view can be copied to the clipboard and pasted into the target application.

DDE (Dynamic Data Exchange) is supported too, so you can paste a link to have the data in the target application updated in real time, if so desired.

Display format

Analysing bunches of numbers can be a time-consuming task, especially if you have to write additional code in a spreadsheet or other application to do it.

A far simpler method is to have PicoScope do the statistical work and present the results in a format that can be interpreted at a glance. This is the purpose of the "data display" settings, which include "current", "average", "minimum & maximum" (envelope) and "accumulate". Let's look at what these do.

The "current" setting is the default (normal) display mode, with the trace redrawn for each cycle (sweep). "Average", on the other hand, draws a trace that represents the average of all cycles since you hit the Go button. Then there's "minimum & maximum" mode, which displays a shaded area representing the minimum and maximum of all cycles.

Finally, "accumulate" draws a new trace for each cycle without erasing the previous one. Several combinations of these modes are supported as well.

Chart recorder mode

For timebase settings of 100ms/div or longer, PicoScope can emulate the classic chart recorder. Instead of rewriting the display each cycle ("standard" mode), you can switch to "chart recorder" or "block" modes.

In chart recorder mode, data is con-

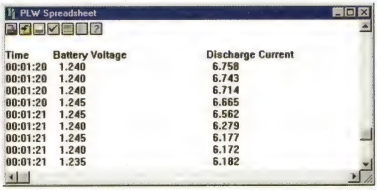


Fig.6: Data is easily exported to other applications via Spreadsheet view.

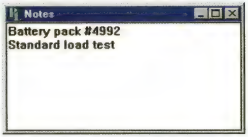


Fig.7: Instead of mental notes, make real one in Notes view. Notes views are saved along with data files, so they provide a simple means of documenting your recordings.

tinuously collected and displayed, with the display "rolling left" when the trace reaches the right-most extremity. Alternatively, in block mode, an entire block of data is collected before being displayed.

X-Y Scope

So far, we've only talked about the oscilloscope instrument, which plots amplitude (the Y-axis) against time (the X-axis).

PicoScope also includes an X-Y oscilloscope, which instead plots the amplitude of channel A against the amplitude of channel B. This view is generally used for comparing the phase of two sine waves.

Most of the measurement options mentioned above do not exist in X-Y Scope view, although the Sampling bar settings are almost identical. Of course, the channel A & B timebases are locked in X-Y mode, so only one timebase is visible.

Spectrum analyser

Unlike the oscilloscope, which plots waveforms in the *time* domain, the spectrum analyser displays information in the *frequency* domain. This provides a means of discovering the amount of "energy" present in a signal, up to a defined frequency limit.

In spectrum view, the horizontal axis is divided into bands of frequencies, displayed in either linear or logarithmic format. The vertical axis is graduated in decibels or volts RMS, representing power.

PicoScope's spectrum analyser operates up to 50MHz, with the upper limit programmable on the Sample bar. The number of frequency bands displayed across the horizontal is selectable via the main Settings menu. The default of 256 allows fast display updates, but up to 4096 points can be selected for the highest accuracy.

As with all digital spectrum analysers, PicoScope employs a mathematical technique called Fast Fourier Transforms (FFTs) to convert the sampled data from the time to the frequency domain.

The application of this conversion causes some distortion of the spectrum peaks, so to minimise the effects on your measurements several compensatory (or "windowing") techniques can be applied. Selections include Rectangle, Triangle, Gaussian, Hamming, Blackman, Parzen and Hanning.

Spectrum measurements

Cursors operate in a similar manner to the Scope view, allowing easy measurement of frequency, amplitude and phase. It is also possible to display average and peak values of successive cycles.

Like Scope views, Spectrum views support a range of automatic measurements.

These include peak frequency, peak amplitude, total power, total harmonic distortion (THD), total harmonic distortion + noise (THD+N), spurious free dynamic range (SFDR), SFDR frequency, signal to noise and distortion ratio (SINAD), signal to noise ratio (SNR), intermodulation distortion (IMD), gain, and amplitudes at the third, fourth, fifth and sixth harmonic.

Meter

PicoScope's Meter views can display either voltage or frequency. The voltmeter display is similar to traditional 4-digit true RMS meters. You can choose between AC, DC and decibel measurement.

Input ranges are identical to the 'scope instrument, including the autoranging functionality. Also in common with the 'scope is the ability to create custom ranges, allowing you to display your measurements in whatever units you desire.

Exporting and printing views

PicoScope provides a means of copying individual views to the clipboard for pasting into your favourite application.

In addition, you can save the selected view as a Windows Bitmap (BMP), Windows Metafile (WMF) or JPEG (JPG) file. Of course, if you want an image of the entire desktop, you can copy it to the clipboard using standard Windows keystrokes. You can also print any or all views on demand.

Saving your settings

PicoScope allows you to save settings and data files for the selected view, or the entire desktop. Any number of individual settings files can be saved and reloaded later as needed.

With a little work, you can even

add buttons to the main menu bar to allow instant reloading of commonly used settings – no need to remember what you named those files!

The ability to save data files is useful for documentation and analysis, and it's great for training purposes, too. Check out Pico Technology's library of waveforms, accessible on their web site, to see how it all works. Some of these waveforms are included in the demo version of PicoScope.

PicoLog

A real bonus with this package is the inclusion of Pico's data logging software, PicoLog. In short, PicoLog collects data in real time and provides a means of analysing, displaying and exporting the results.

In a similar vein to PicoScope, data is displayed in a number of different "views", specifically: Recorder, Spreadsheet, Notes, XY Graph, Graph and Player. Let's touch briefly on the highlights of some of these views.

Recorder view

All other views are launched from the Recorder view, which essentially defines and controls all recording runs. Go, Stop, Pause and Rewrite buttons control recording state once a run has been defined.

The sampling interval, number of samples per run (up to a million) and number of readings per sample are all individually programmable. Once a run is complete, PicoLog can be programmed to "stop", "repeat immediately", "repeat after delay" or "scroll". In scroll mode, oldest samples are discarded to make room for new as the run repeats.

An unlimited number of runs, complete with associated settings, can be saved to disk or previous runs reloaded at will. For multiple runs, an incrementing number is automatically appended to the specified file name.

A powerful feature of PicoLog is its ability to perform calculations on measured data using inbuilt mathematical operators and functions. Expressions can contain up to five parameters and can include the results of other calculations. Each calculated parameter can have its own, programmable, units of measure and scale factor.

If you'd like to control PicoLog remotely, you can do that too. The latest release of the software (R5.08) includes IP connectivity so that you can connect two machines running PicoLog over a network. One machine acts as a server and supplies the data. The other acts as a client, behaving exactly as if the data were available locally. Up to 10 clients can connect to one PicoLog server.

Graph

The Graph view looks and feels a lot like a chart recorder. Buttons arranged at the top and side of the view provide quick access to all settings and controls.

Display format is entirely customisable. Multiple traces can be displayed on a single graph or on separate graphs (all within the Graph view). Axis scaling and markings can be formatted to suit all tastes.

Manual control over "pen" and "paper" is provided by the surrounding buttons, and there's even a magnifying glass (zoom)!

When multiple traces are displayed on one graph, PicoLog can insert markers (circles, triangles, etc) on the traces for easy identification. Two clicks save the current view to disk as a Windows Bitmap (BMP), Windows Metafile (WMF) or JPEG (JPG) file.

With the "auto-save" option enabled, all settings are saved to disk when the Graph view is closed.

Spreadsheet

This view provides a convenient method of locating and exporting data. As the name implies, readings are displayed in columnar format and can be listed numerically, by "time since start", "time of day", or "date/time".

In addition, each row can display an aggregate of values over a specified number of samples. Readings can be aggregated to "first reading", "average" and "maximum & minimum".

Once you've formatted the list and selected the area of interest, you can print it, copy it to the clipboard or just save the data to disk in tab-delimited format.

As with the Graph view, all settings are retained when the "auto-save" option is enabled.

Notes view

A simple method of identifying and otherwise annotating recordings is provided by the Notes view. Notes you type here are displayed at the foot of printed reports as well.

Player view

The Player view is just like the Recorder view – but without the recording capability. This enables you to work with data from a previous recording run while another is in progress.

In fact, the Player can be launched as a stand-alone program, allowing you to open data files on any PC with a minimum of additional software.

Impressions

PicoScope and PicoLog appear to include just about every possible option without resorting to burying anything in multilevel menu selections. The on-line help is quite helpful, too. On the hardware side, the specifications for a package at this price are very respectable.

If you've used a DSO before, you'll have no problems driving the ADC-212 out of the box. New users will need to invest some time learning the ropes to get the most from their purchase.

More information

Check out the demo versions of PicoScope and PicoLog, available free from the Pico Technology web site at www.picotech.com.

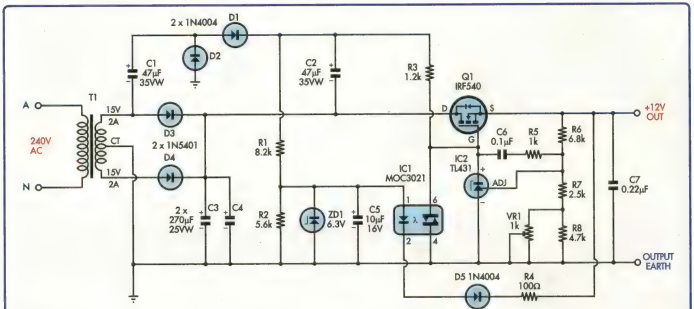
You can also download the ADC-212 and PicoScope/PicoLog user manuals in PDF format.

At time of press, the ADC-212/100 was priced at $2,284 (excluding GST). This price includes all of the above software on CD, printed installation guide, parallel cable, plugpack AC adapter and one-year warranty. The PP-123 battery pack will set you back another $350 (excluding GST).

Pico Technology products are distributed in Australia by Emona Instruments, telephone (02) 9519 3933 or email testinst@emona.com.au. They're also on the web at www.emona.com.au. SC

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Ultra low drop linear voltage regulator

This circuit is a Mosfet-based linear voltage regulator with a voltage drop of as low as 60mV at 1A. The circuit uses a 15V-0-15V transformer and employs an IRF540 N-channel Mosfet (Q1) to deliver the regulated 12V output.

The gate drive voltage required for the Mosfet is generated using a voltage doubler circuit consisting of diodes D1 & D2 and capacitors C1 & C2. To turn the Mosfet fully on, the gate terminal should be around 10V above the source terminal which is connected to the DC output. The voltage doubler feeds this voltage to the gate via resistor R3.

IC2, a TL431 adjustable shunt regulator, is used as the error amplifier. It dynamically adjusts the gate voltage to maintain the regulation at the output.

With an adequate heatsink for the Mosfet, the circuit can provide up to 3A output at slightly elevated minimum voltage drop. Trimpot VR1 is used for fine adjustment of the output voltage. The RC network consisting of R5 and C6 provides error-amplifier compensation.

The circuit is provided with short-circuit crowbar protection to guard against an accidental short at the output. This crowbar protection works as follows: under normal working conditions, the voltage across capacitor C5 will be 6.3V and diode D5 will be reverse-biased by the output voltage of 12V. However, during output short-circuit conditions, the output will momentarily drop, causing D5 to conduct. This triggers the MOC3021 Triac optocoupler (IC1) which in turn pulls the gate voltage to ground.

This limits the output current. The circuit will remain latched in this state and the input voltage has to be switched off to reset the circuit.

www.electronic-circuits-diagrams.com/psimages/powersupplies\ckt3.shtml

Simple logic probe

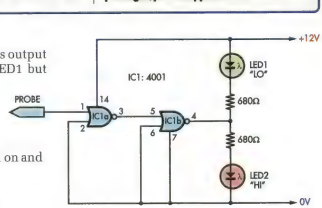
This simple logic probe has both LEDs on with no signal at the input but due to the nor gates connected to the probe, indicates correctly when a high or low signal is present.

It also works correctly for pulse trains.

Normally both LEDs are forward biased and therefore on, powered by the 12V supply. When a logic "high" is present at the probe, IC1a's output goes low sending IC1b's output high. This turns off LED1 but forward-biases (and turns on) LED2.

Conversely, a logic "low" at the probe will send IC1b low, turning LED1 on and LED2 off.

F. Edwards,
Ardross, WA. ($25)



12V car battery charger

Unlike many units, this battery charger continuously charges at maximum current, tapering off only near full battery voltage. In this unit, the full load current of the supply transformer/rectifier section was 4.4A. It tapers off to 4A at 13.5V, 3A at 14.0V, 2A at 14.5V and 0A at 15.0V.

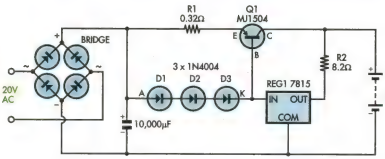
Transistor Q1, diodes D1-D3 and resistor R1 form a simple constant current source. R1 effectively sets the current through Q1 – the voltage across this resistor plus Q1's emitter-base voltage is equal to the voltage across D1-D3. Assuming 0.7V across each diode and across Q1's base-emitter junction, the current through R1 is approximately 1.4/0.34 = 4.1A.

REG1 ensures that Q1 (and thus the constant current source) is turned on. When the battery has fully charged, the current through REG1 drops to a very low value and so Q1 turns off (since there is no longer any base-emitter current).

R2 limits the current through REG1. It allows enough current to flow through the regulator so that Q1 is fully on for battery voltages up to about 13.5V. Decreasing the value of R2 effectively increases the final battery voltage by raising the current cutoff point. Conversely, a diode in series with one of the battery leads will reduce the fully-charged voltage by about 0.7V.

Finally, the MJ1504 requires a good heatsink. The 7815 is mounted on the same heatsink and will throttle the circuit back if Q1 gets too hot.

Trevor Murray,
East Maitland, NSW. ($30)



Battery tester for deaf-blind persons

Many blind and deaf-blind persons use portable electronic devices to assist their everyday lives but it is difficult for them to test the batteries used in this equipment. Talking voltmeters are available but there is no equivalent usable by deaf-blind persons.

This battery tester uses vibration and a user-settable control to enable blind and deaf-blind persons to test both ordinary and rechargeable AAA, AA, C, and D cells and 9V batteries. For ease of use and maintenance the device is powered by the battery under test.

The design is dominated by the fact that the pager motor will operate down to only 0.7V. With a 0.3V drop from the switching transistor, a weak cell, at 1.0V, will only just operate the motor. This means that the 1.5V cell sensing circuitry cannot be isolated from the 9V test terminals using steering diodes - they would introduce too great a voltage drop. The solution was to duplicate the level sensing circuitry for each set of test terminals.

On the 1.5V side of the circuit, a resistance network consisting of two 10kΩ multi-turn trimpots (VR2 & VR3) and user control VR1a produces an adjustable proportion of the voltage of the cell under test. VR1a selects a division ratio between the low and high limits set by the trimpots. The resistance of VR1a is 10 times larger than the resistance of these trimpots to minimise the interaction between their settings.

The voltage from the resistance network is applied to a combined threshold detector and current amplifier formed by Q1 to Q4 and associated components. When the threshold (about 0.6V) is exceeded the pager motor is energised, causing the battery tester to vibrate.

In use, VR1 is first set to its fully counter-clockwise position, then a cell is connected. If the cell's voltage exceeds the 1V low threshold set by the 1.5V LOW trimpot (VR2), the battery tester will vibrate. Rotating VR1 clockwise applies a progressively lower voltage to the threshold detector until a point is reached when the threshold is no longer exceeded and the pager motor switches off. The angle of rotation of VR1 then indicates the voltage on the battery. VR1 is fitted with a pointer knob to make the angle of rotation easy to feel.

Having the pager motor switch off rather than switch on ensures that the voltage of the battery is sampled while it is supplying the load of the pager motor. This gives a more accurate indication of the state of the battery than its open-circuit voltage.

To ensure that the user turns VR1 clockwise during the test, the circuit is designed so that once vibration has ceased, it cannot be made to start again by rotating VR1 counter-clockwise. This also eliminates any possibility of user confusion arising from any hysteresis in the circuit.

This feature is implemented by Q5, which forces the base of Q2 high if Q4 ceases to conduct strongly. A 1μF capacitor between the base and emitter of Q5 forces it off when power is first applied, to give Q4 a chance to conduct. The parallel 1MΩ resistor discharges the 1μF capacitor when power is removed, to reset the circuit.

To prevent the pager motor being driven through the base-emitter junction of Q5, the base of Q5 is connected to the collector of Q4 via 10kΩ resistor. Another 10kΩ resistor is connected in parallel with the pager motor to ensure that Q5 switches on when Q4 switches off.

The 9V test circuit is similar to the 1.5V circuit. A 68Ω 1W resistor limits the current through the motor to prevent it from being over-driven by the higher voltage. In addition, there is a series diode to protect the 9V circuitry against reverse polarity. A diode is not possible for the 1.5V side of the circuit because it would introduce too great a voltage drop; fortunately, it is also unnecessary since 1.5V is below the reverse breakdown voltage of the transistors used.

The 1μF capacitor across the pager motor smoothes the load provided by

Awaken the deaf!

Small alarm clocks and clock-radios often have squeaky piezo buzzers which may or may not be able to awaken a hard-of-hearing sleeper. Their pitch is up in the region where hearing loss is often greatest.

Larger clocks in a plastic case may have an alarm bell consisting of a small motor which, as it rotates, flings a tiny washer into contact with a tinny bell. They are better – but still not loud enough for some. Here's my solution to the problem.

You start with a clock with a bell. Unplug it from the mains, then take the case apart and find the bell motor and the two pins to which it is connected. You may have to ease the motor out to get at the pins.

With power reconnected, adjust the clock settings until the alarm sounds (ie, motor starts) and carefully measure which of the two pins is positive. Mark this pin. Disconnect power and remove the motor and the bell.

On a small scrap of strip board or even tagstrip, build the circuit shown. It is just a very simple transistor switch. When the alarm is triggered the transistor is turned on and the electro-mechanical buzzer sounds off.

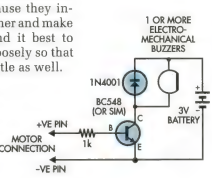
This is much louder than the bell. The mute switch may be needed – depending on the original switching method.

The circuit board can be mounted inside the clock case, but the buzzer should be mounted on the side closest to the user for maximum effect.

Actually two buzzers are much better than one because they interfere with one another and make quite a din. I found it best to mount the buzzers loosely so that as they buzz they rattle as well.

The 3V battery (2xAA cells in a holder) can usually be squeezed inside the back of the case.

A. J. Lowe, Bardon, Qld. ($25).



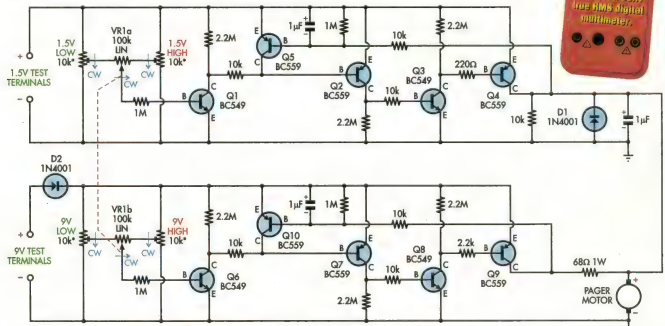
the motor so that measurements made by the circuit are consistent from one trial to another. The 1N4001 diode across the pager motor clips any back-EMF generated by the motor.

A D-cell holder and an AA-cell holder connected in parallel were used for the 1.5V test terminals. The 9V test terminals are the studs from a standard 9V snap screwed to the box.

To calibrate the battery tester, start with VR1 fully counter-clockwise. First adjust the 1.5V LOW trimpot by turning it fully counter-clockwise, then apply 1.0V to the 1.5V test terminals and turn the trimpot slowly clockwise until vibration just ceases. Now turn VR1 fully clockwise and adjust the 1.5V HIGH trimpot similarly with 1.6V applied to the 1.5V test terminals. There is a small amount of interaction between the low and high settings, so repeat the adjustment of the 1.5V LOW trimpot. Similarly, calibrate the 9V side of the circuit for a range of 6.0V to 9.6V.

To test a battery, rotate VR1 fully counterclockwise before connecting the battery to the appropriate set of test terminals (1.5V or 9V). If the device does not vibrate, the battery is completely dead. Otherwise, rotate VR1 slowly clockwise until the device just ceases to vibrate. The position of VR1 then shows the condition of the battery under test.

Andrew Partridge, Kuranda, Qld.



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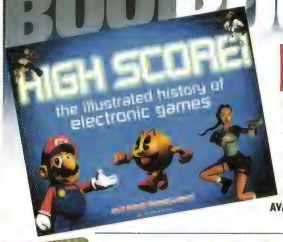

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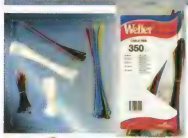

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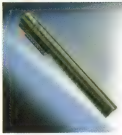

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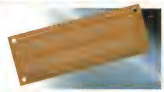

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This high efficiency inverter will power 36W or 40W tubes from a 12V battery and it is dimmable by about 20% for even more power saving. Overall inverter efficiency is about 70%. It can be used for camping, recreational vehicles, emergency lighting or as part of a solar power installation in remote areas.

Fluorescent tubes use far less energy than incandescent lamps and fluorescent tubes last a great deal longer as well. Other advantages are diffuse, glare-free lighting and low heat output.

For these reasons, fluorescent lighting is the natural choice in commercial and retail buildings, workshops and factories. For battery-powered lighting, fluorescent lights are also the first choice because of their high efficiency.

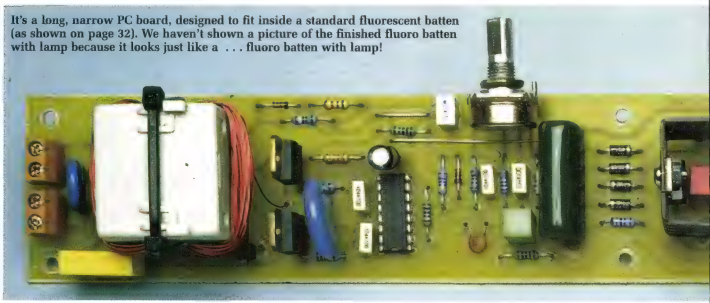
The main drawback with running fluorescent lights from battery power is that an inverter is required to drive the tubes. Inverter efficiency then becomes the major issue.

There are many commercial 12V-operated fluorescent lamps available which use 15W and 20W tubes. However, it is rare to see one which drives them to full brilliance. For example, a typical commercial dual 20W fluorescent lamp operating from 12V draws 980mA or 11.8W. Ignoring losses in the fluorescent tube driver itself, it means that each tube is only supplied with 5.9W of power which is considerably less than their 20W rating. So while the lamps do use 20W tubes, the light output is well below par.

Our new fluorescent inverter drives 36W or 40W tubes to full brilliance and has the option to dim the tube down to about 80% brightness. So not only do you get full brightness when you want it but you can dim the tube down when full brightness is not required and you want to conserve power drawn from the battery.

Built on a long thin PC board, the inverter fits easily into a standard 36/40W batten.

Drive for the fluorescent tube is controlled with a specialised IC which provides filament preheating before the tube is ignited. Once the tube is alight it monitors the tube current to maintain constant brightness. This current feedback control also provides for the dimming feature.



It's a long, narrow PC board, designed to fit inside a standard fluorescent batten (as shown on page 32). We haven't shown a picture of the finished fluoro batten with lamp because it looks just like a . . . fluoro batten with lamp!

ncy inverter
nt tubes

By JOHN CLARKE

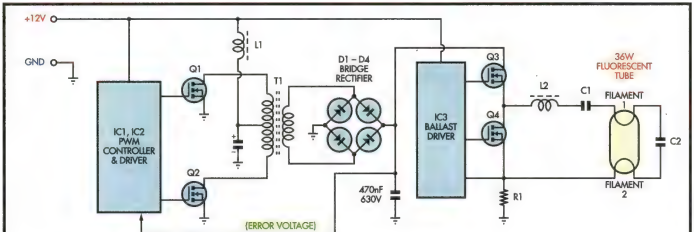


Fig.1: two switch-mode circuits are involved here: the DC-DC inverter involving IC1, Q1 & Q2 and the fluoro tube driver which converts high voltage DC to AC via IC3 and Q3 & Q4 in a totem-pole circuit.

By the way, this project is quite similar in concept to the fluorescent inverter described in the November 1993 issue of SILICON CHIP. This earlier circuit is now superseded.

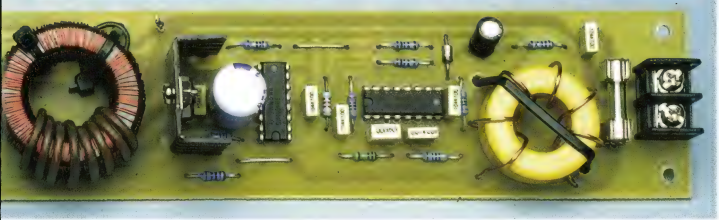
Block diagram

Fig.1 shows the general arrangement of the fluorescent inverter. The 12V supply is stepped up to 334VDC using IC1 & IC2, Mosfets Q1 & Q2 and transformer T1.

IC1 is the well-known Texas Instruments TL494 pulse width modulation controller. The internal functions of IC1 are shown in Fig.2. It contains a sawtooth oscillator, two error amplifiers and a pulse width modulation comparator. It also includes a dead-time control comparator, a 5V reference and output control options for push-pull or single ended operation.

Oscillator components at pins 5 and 6 set the operating frequency and for our circuit this is around 100kHz. This frequency was selected to enable use of a relatively small toroidal core for

Warning: This circuit generates in excess of 300V DC which could be lethal. Construction should only be attempted by those experienced with mains-level voltages and safety procedures.



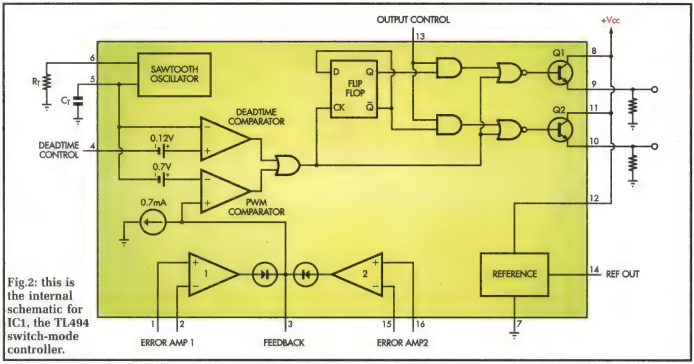


Fig.2: this is the internal schematic for IC1, the TL494 switch-mode controller.

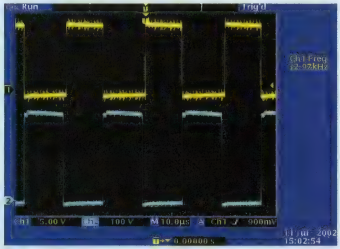
the transformer. The PWM controller generates variable width output pulses at pins 9 and 10, to ultimately drive the gates of Mosfets Q1 and Q2 via the CMOS buffers in IC2, a 4050 hex buffer package.

Mosfets Q1 and Q2 drive the centre-tapped primary winding of transformer T1. The centre-tap of the transformer's primary winding connects to the +12V supply while each side of the primary winding is connected to a separate Mosfet. Each Mosfet is driven with a squarewave so that when Q1 is on, Q2 is off and when Q2 is on Q1 is off.

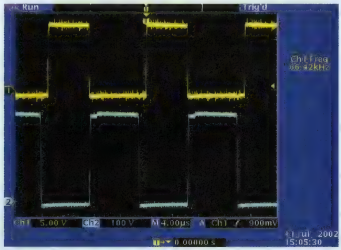
With Q1 on, 12V is applied to the top half of the transformer primary winding. Similarly, when Q2 turns on, 12V is also impressed across the lower primary winding. The resulting square waveform on the primary is then stepped up by the secondary winding. High speed diodes rectify the AC output from the transformer T1, while a 470nF 630V capacitor (C4) filters the output to provide a stable DC voltage.

A portion of the DC voltage output (called the error voltage) is returned to IC1 for feedback control and the pulse width modulation is varied to maintain the 334V output.

The high voltage DC from the inverter is applied to the fluorescent tube via Mosfets Q3 & Q4 and an LC network consisting of L2 and C1. Mosfets Q3 & Q4 are switched alternately by the ballast driver IC3, an L6574 fluorescent ballast driver, made by SGS-Thomson. The resulting squarewave signal is applied through inductor L2 and capacitor C1 to the



Scope1: These two waveforms show the gate drive to Q3 and Q4 when the fluorescent tube is at full brightness. Top trace is the gate drive to Q4, a nominal 12V peak-to-peak signal. Lower trace is the gate drive to Q3, which is from 0-334V plus the gate voltage when switched on. The small step in the top of the waveform is when the gate goes to 12V above the 334V supply.



Scope2: These waveforms are identical to those in Scope1 except that now the frequency is much higher, at 65kHz, to dim the fluorescent tube. Notice the "dead time" between Q4 being switched off to Q3 switched on. This prevents high current pulses which would destroy the Mosfets if both were on at the same time.

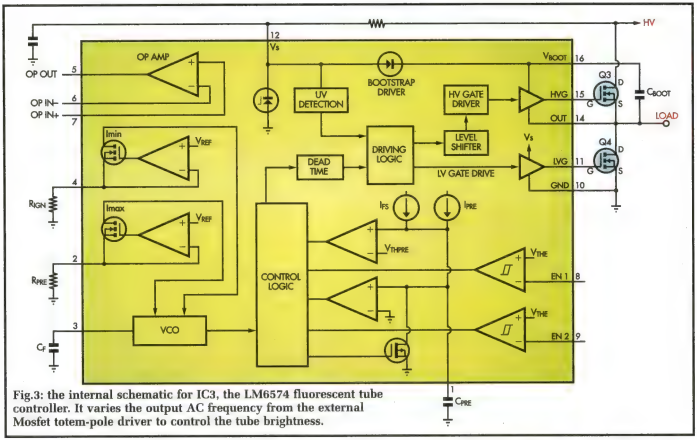
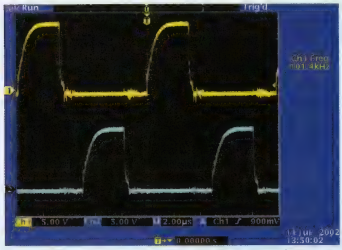


Fig.3: the internal schematic for IC3, the LM6574 fluorescent tube controller. It varies the output AC frequency from the external Mosfet totem-pole driver to control the tube brightness.

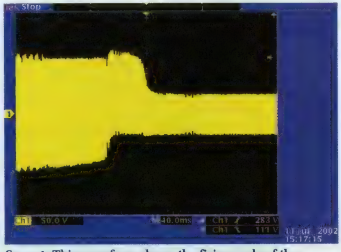
fluorescent lamp. The inductor is included to provide AC current limiting while capacitor C1 blocks DC current flow.

During the starting phase, Q3 and Q4 are driven at a very high frequency and this provides a current flow through L2 and C1, the top tube filament, through C2 and the lower tube filament and then to ground via the current sense resistor R1. This current is limited to a low value by the impedance of L2 and it heats up the lamp filaments so the tube start easily. After about one second, the drive frequency is lowered to the series resonant frequency of L2 and C2 and the resulting high voltage across C2 fires the tube. Once the tube is fired, the drive frequency is further reduced to provide full tube brightness.

As you might expect, there is a fair amount of circuitry packed into the ballast driver IC; its internal workings are shown in Fig.3. An oscillator section comprises the VCO (voltage controlled oscillator) and the current



Scope3. These are the gate drive signals to Q1 and Q2 when the fluorescent tube is driven to full brightness. Frequency is around 100kHz. Note the "dead time" between one Mosfet turning off and the second Mosfet turning on.



Scope4: This waveform shows the firing cycle of the fluorescent tube and is an attenuated signal of the actual tube voltage. The voltage is initially high and then drops once the tube has fired.

The PC board mounted in the fluoro batten. It doesn't take up much space – in fact, there's plenty of room inside the batten for some gell cell batteries and maybe a charger for an emergency light. Gee, we could be onto something here . . .

sources set by resistors R_{IGN} and R_{PRE} at pins 4 and 2 respectively. Frequency during starting is controlled by resistor R_{PRE} in conjunction with capacitor C_F at pin 3. This sets the maximum frequency. Once the tube is started, the frequency is set by R_{IGN} and capacitor C_F. An op amp at pins 5, 6 & 7 can be used for frequency control.

The duration of the tube filament preheat is set by capacitor C_{PRE} at pin 1. The enable inputs at pins 8 & 9 can be used to reinitiate starting if the tube does not fire or to shutdown the circuit if a tube is not installed.

The gate drive for the Mosfets is interesting. Mosfet Q4 is driven directly via the low voltage gate (LVG) driver at pin 11. When pin 11 goes high, Q4 is switched on and when pin 11 is low, Q4 is off.

High side switching

Mosfet Q3 requires a special gate driver to allow it to drive the high voltage (HV) supply. The special gate driver comprises the bootstrap diode, level shifter, high voltage driver (HVG) and capacitor C_{BOOT} between the source of Q3 and V_{BOOT}. When Q4 is switched on, Q3 is off and so capacitor C_{BOOT} can be charged from the supply at V_S via the bootstrap diode and Q4 (to ground).

Thus C_{BOOT} will have the supply voltage across it. When Q4 is switched off and Q3 is switched on, the entire gate drive section for Q3 is pulled up to the HV supply and the gate drive is higher than this by the V_S supply stored on C_{BOOT}. The gate drive circuit (HVG) thus maintains its supply from C_{BOOT}. The bootstrap diode is now reverse biased and plays no further part in the operation.

When Q3 is switched off and Q4 is switched on, C_{BOOT} can be topped up via the bootstrap diode again. The capacitor value needs to be sufficiently large to prevent the HVG driver supply from drooping as it needs to charge the gate capacitance of Q3.

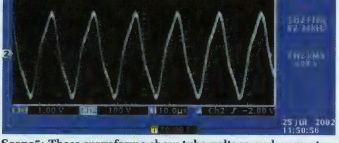
Circuit details

The full circuit of the fluorescent inverter is shown in Fig.4. IC1 is the TL494 PWM controller. Its frequency of operation set at around 100kHz by the 4.7kΩ resistor and 1nF capacitor at pins 6 and 5 respectively.

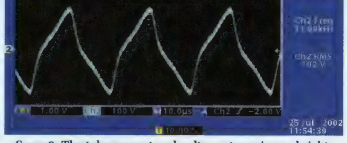
The emitter outputs at pins 9 and 10 are pulled down via 1kΩ resistors and they each drive three paralleled buffers in IC2. Mosfets Q1 and Q2 drive the transformer as described previously to develop the high voltage supply across T1's secondary winding. High frequency rectifiers D1-D4 convert the AC waveform into a DC voltage and this is filtered with a 470nF 630V capacitor (C4). The 10nF 3kV capacitor (C3) is included so that it can be placed directly between the drain of Q3 and the source of Q4 to provide decoupling of this supply. This limits voltage overshoot as Q3 & Q4 switch on and off. Left uncontrolled, too much voltage overshoot can damage the Mosfets.

Feedback from the high voltage DC output is derived from a resistive divider comprising two series 270kΩ resistors and an 8.2kΩ resistor. The resulting voltage across the 8.2kΩ resistor is applied to internal error amplifier 1 in IC1 at pin 1. The divider ratio is such that pin 1 will be 5V when the DC voltage is 334V. The DC gain of the error amplifier is 213 times, as set by the 1MΩ and 4.7kΩ resistors at pin 2. The 47kΩ resistor and 100nF capacitor across the 1MΩ feedback resistor provide fast AC response from the circuit.

This op amp is referenced to +5V (pin 14) via the 4.7kΩ resistor. Thus its output at pin 3 will be +5V if the high voltage DC level is 334V but will go lower than this if the DC voltage



Scope5: These waveforms show tube voltage and current when the tube is in starting mode. Top trace is the tube current while the lower trace is the voltage across the tube. Operating frequency is 62kHz.



Scope6: The tube current and voltage at maximum brightness. The frequency has now dropped to 33kHz and current is higher. Notice that the voltage waveforms are reasonably clean, producing much less radio interference than from a fluorescent tube operated with a conventional ballast.

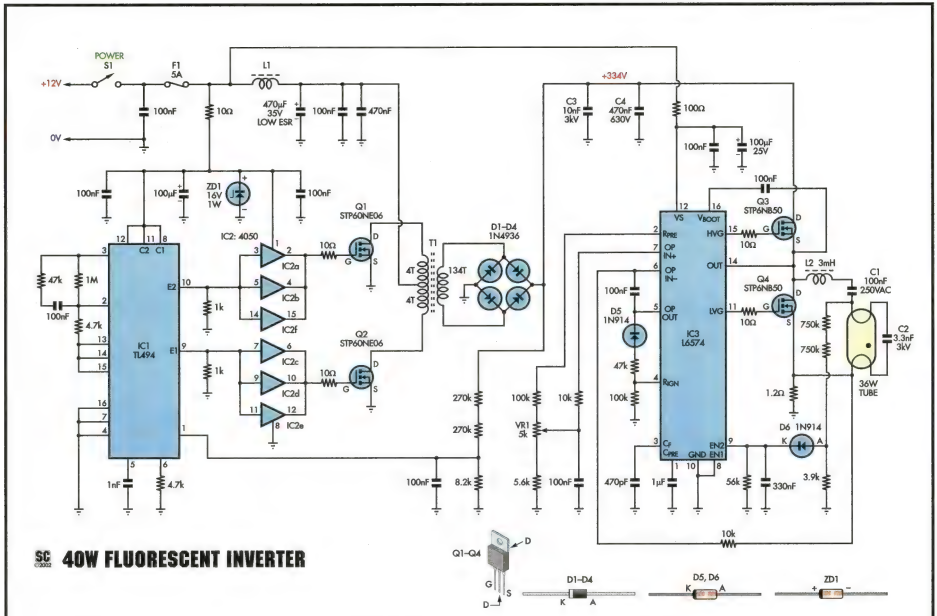


Fig.4: the full circuit of the fluorescent inverter. IC3 is the clever component, varying the tube drive frequency between 100kHz and about 30kHz to preheat the filaments, ignite the tube and then maintain the tube current at the correct value.

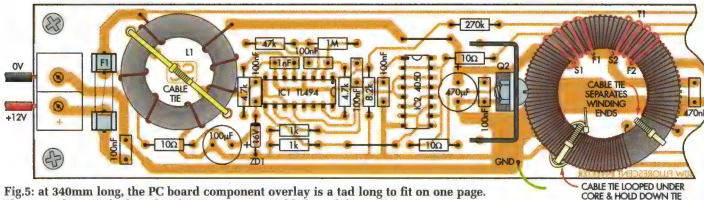


Fig.5: at 340mm long, the PC board component overlay is a tad long to fit on one page. If you need to cut the board to fit it into, say, an odd-shaped fluoro lamp (eg, circular), the logical place would be across the screw holes, four diodes and 270kΩ resistor.

falls. As mentioned previously, the op amp output is compared with the sawtooth oscillator waveform to control the PWM drive to the Mosfets.

Power to IC1 and IC2 is supplied via a 10Ω resistor from the 12V supply and filtered with a 100µF capacitor. A 16V zener diode protects the circuit from high voltage transients. The main current supply to transformer T1 is supplied via inductor L1 and filtered with the 470µF electrolytic capacitor. The 100nF and 470nF capacitors are included to supply the high frequency peak currents demanded by the switch-mode operation of T1.

Reverse polarity protection is provided with fuse F1 in conjunction with the substrate diodes of Mosfets Q1 & Q2. Should the battery connection leads be transposed, the diode within Q1 or Q2 conducts and the fuse will blow. IC1 and IC2 are protected via zener diode ZD1 which will also limit the positive supply voltage to -0.7V below ground.

Supply to IC3 comes from the 12V rail via a 100Ω current limiting resistor which prevents possible damage to the internal zener diode at pin 12. This zener also protects the IC from reverse polarity connection. The supply is decoupled with 100µF and 100nF capacitors. The high side driver supply capacitor C_{BOOT} is 100nF in value.

Frequency of operation during preignition is set at around 100kHz by the 470pF capacitor at pin 3 and the R_{PRE} value at pin 2. Preheat time is fixed at 1.5s using the 1µF capacitor at pin 1. Note that this capacitor must have very low leakage since its charging current is only 2µA. For this reason, we have specified a polyester type in this position; do not substitute an electrolytic.

After the filament preheat, the frequency falls to about 33kHz, set by the 100kΩ resistor at pin 4. Before this low frequency is reached, the tube is ignited at the series resonant frequency of L2 and the 3.3nF capacitor across the tube. This occurs at around 60kHz.

The resulting tube current flows through the 1.2Ω resistor at Q4's source and the voltage developed across it is monitored via a 10kΩ resistor at pin 6, the inverting input of an internal op amp. The non-inverting input to the op amp is connected to the wiper of VR1 via a 10kΩ resistor. A 100nF capacitor between the inverting input to the op amp and the output filters the resulting output and this controls the value of R_{IGN} at pin 4 via diode D5.

When pin 5 of the op amp is high, diode D5 is reverse biased and the frequency of operation is simply set by the 100kΩ resistor at pin 4, to 33kHz. When pin 5 is low, R_{IGN} is the 100kΩ resistor to ground in parallel with the 47kΩ resistor connecting to diode D5. The frequency of oscillation thus rises.

The internal op amp can therefore control the frequency of operation in a feedback loop where it monitors the tube current against the reference set by potentiometer VR1. Varying the frequency also changes the tube current (and brightness) because the impedance of inductor L2 increases as the frequency rises.

The enable 2 (EN2) input at pin 9 is used to cause the circuit to begin preheating again if the tube does not fire. Two series 750kΩ resistors and a 3.9kΩ resistor divide the voltage at the

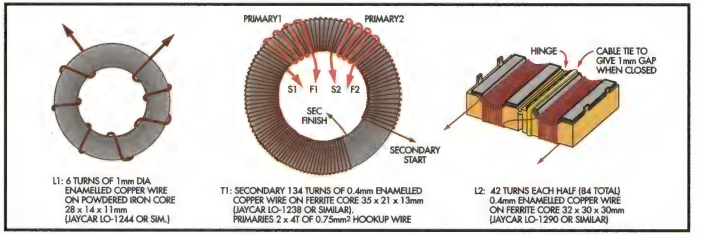
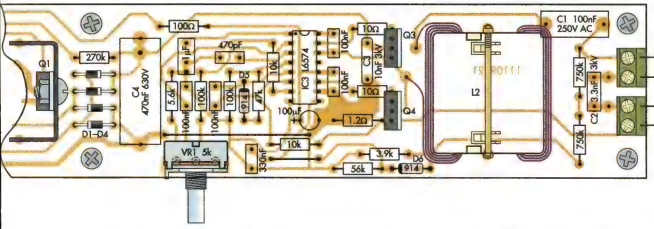


Fig.6: winding details for the inductors and inverter transformer. L2 is held in place with three small cable ties, daisy-chained to lock it in place.



top of the tube down to a low value which is then rectified by diode D6 and fed to pin 9.

If the tube does not fire after the first preheat and ignition sequence, the voltage across the tube will remain much higher than if the tube had fired and started. If the voltage at pin 9 exceeds the 0.6V threshold, the ignition process will repeat until the tube fires and lights. In practice, the tube may need to undergo several preheat sequences when the temperature is low or if it is an old tube, but will fire on the first attempt when the tube is warm.

Construction

The Fluorescent Inverter is built on a long narrow PC board coded 11109021 and measuring 340 x 45mm. It fits easily into in a standard fluorescent 36/40W batten. Its wiring diagram is shown in Fig.5.

You can begin assembly by checking the PC board for shorts between tracks and possible breaks in the copper pattern. Also check that the hole sizes are suitable for the components.

The six mounting holes, the heatsink mounting tab holes and cable tie holes should be 3mm in diameter, while holes for the screw terminals and fuse clips need to be 1.5mm in diameter.

Insert the wire links and resistors first, using the resistor colour codes as a guide to selecting the correct values. You can also use a digital multimeter to check the values directly. Then install the ICs and diodes, taking care with their orientation.

Install the capacitors next, using the Table as a guide. Make sure that the high voltage 470nF and 10nF capacitors are installed in the correct positions. If you inadvertently put the low voltage capacitors in the wrong positions, they will blow at switch-on.

When inserting the two fuse clips, note that they have little end stops which must be placed to the outside edge to allow the fuse to be clipped in place. The screw terminals can be inserted and soldered in place. When inserting the two heatsinks, bend the mounting lugs over on the underside of the PC board to secure them in place.

Insert the Mosfets, taking care to put the correct type in each position. Q1 and Q2 are screwed to their heatsinks with an M3 screw and nut before they are soldered to the PC board. Potentiometer VR1 can now be installed.

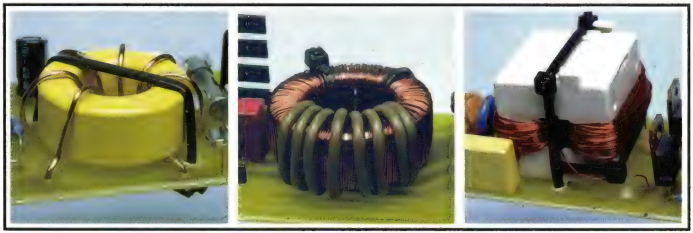
Winding the toroids

Three cores need to be wound, for L1, L2 and transformer T1. The winding details are shown in Fig.6.

Beginning with L1, use a 28 x 14 x 11mm iron powdered toroidal core and wind on six evenly spaced turns of 1mm diameter enamelled copper wire. Strip the wire ends of insulation and tin them (with solder) before soldering to the PC board. Secure the toroid with two 100mm cable ties daisy-chained to extend the length and through the holes allocated on the PC board.

Transformer T1 is wound on a 35 x 21 x 13mm ferrite toroid. First wind on the secondary 134 turns of 0.4mm diameter enamelled copper wire. Wind these tightly together around the core, leaving a few millimetres spacing between the start and finish ends of the windings.

Fit a cable tie between the start and



Close-up photos of L1, T1 and L2 (as drawn at left) to help you with their construction. The winding on L1 occupies only about 3/4 of the toroid while the secondary of T1 (which goes on first) occupies all of its toroid.

Parts List – 12V Fluorescent Light Inverter

1 36/40W fluoro batten with tube
1 PC board, coded 11109021 (340 x 45mm)
1 Powdered iron toroidal core, 28 x 14 x 11 (L1; Jaycar LO-1244 or equivalent)
1 Ferrite core, 32 x 30 x 30mm (L2; Jaycar LF-1290 or equivalent)
1 Ferrite toroidal core, 35 x 21 x 13mm (T1; Jaycar LO-1238 or equivalent)
1 16mm 5kΩ linear potentiometer with knob (VR1)
2 M205 fuse clips
1 M205 quick blow 5A fuse (F1)
1 2-way PC-mount screw terminal blocks (Altronics P-2101 or equivalent)
2 2-way PC-mount screw terminal blocks (Altronics P-0234A or equivalent)
2 Mini-U TO-220 heatsinks 25 x 30 x 12.5mm
1 150mm length of 0.8mm tinned copper wire
1 250mm length of 1mm diameter enamelled copper wire
1 15m length of 0.4mm enamelled copper wire
1 500mm length of 7.5A-rated (0.75mm^2) hookup wire
1 500mm length of green (or green/yellow) hookup wire
1 2m length of red and black automotive figure-8 wire, 1mm square section
2 automotive battery clips (1 red and 1 black)
6 M3 tapped metal spacers x 6mm long
2 M3 x 6mm screws
6 M3 x 15mm screws
8 M3 nuts
1 cord-grip grommet
13 100mm cable ties
1 PC stake

Semiconductors

1 TL494 switch-mode controller (IC1)
1 4050 hex CMOS buffer (IC2)
1 L6574 fluorescent ballast driver (IC3)
2 STP60NE06 60V Mosfets (Q1,Q2)
2 STP6NB50 500V Mosfets (Q3,Q4)
1 16V 1W zener diode (ZD1)
4 1N4936, UR104 fast diodes (D1-D4)
2 1N914, 1N4148 switching diodes (D5,D6)

Capacitors

1 470µF 35V or 50V low ESR PC electrolytic
2 100µF 16V PC electrolytic
1 1µF MKT polyester
1 470nF (0.47µF) MKT polyester
1 470nF (0.47µF) 630V polyester (C4)
1 330nF (0.33µF) MKT polyester
10 100nF (0.1µF) MKT polyester
1 100nF (0.1µF) 250VAC class X2 MKT polyester (C1)
1 10nF (0.01µF) 3kV ceramic (C3)
1 3.3nF (0.0033µF) 3kV ceramic (C2)
1 1nF (0.001µF) MKT polyester
1 470pF ceramic

Resistors (0.25W, 1%)

finish of this winding to maintain the separation, then insert the wire ends into the relevant PC board holes and temporarily tie them together, under the PC board.

The primary windings are wound over the secondary. Strip a 3mm length of insulation from one end of some 7.5A-rated (0.75mm^2) hookup wire and solder it into the S1 hole of the PC board, as shown on Fig.5.

Now wind on four turns in the direction shown and then cut and strip the wire insulation at a length suitable for inserting into the F1 hole. Solder this wire in position. Note that the windings must be reasonably tight around the toroid.

Then wind the second primary winding in the same manner, starting in the S2 hole and finishing at the F2 hole in the direction shown. It sounds tricky bit you will find that you can easily thread the hookup wire under and through the toroid.

The toroid is secured using a cable tie wrapped around the core as shown and spaced above the PC board using another looped cable tie placed side on. This lifts the core so that it is at the same height as the primary winding side.

Inductor L2 is wound on a split ferrite core with a gap of 1mm. This gap is necessary to prevent core saturation and also to reduce its Q. This gap is set by inserting a cable tie in the hinge portion of the split core. This is shown in the detail diagram for L2 in Fig.5.

Wind 42 turns of 0.4mm enamelled copper wire onto each core half, so that in effect, you have an 84-turn coil split between them. Insert the cable tie and snap close the core. The core is secured to the PC board with a daisy-chained length of cable ties around the top and through the holes in the PC board. Then strip, tin and

Capacitor Codes

Value	Old Value	IEC Code	EIA Code
1µF	1µF	1u	105
470nF	0.47µF	470n	474
330nF	0.33µF	330n	334
100nF	0.1µF	100n	104
10nF	.01µF	10n	103
3.3nF	.0033µF	3n3	332
1nF	.001uF	1n0	102
470pF	470pF	471	470

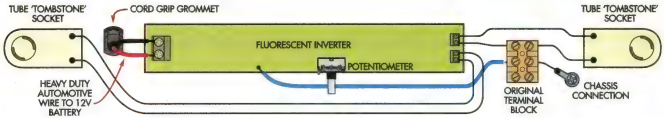


Fig.7: here's how the PC board is wired into a standard 36/40W fluorescent light batten. The starter and its holder are discarded but the original tombstones and terminal block are retained. Any power factor capacitor is also removed.

solder the two winding ends to the PC board.

Installing the board

The PC board is installed into a standard 36/40W batten and mounted on 6mm high metal spacers. Before you can do that, you must remove the original ballast and the starter components. Find a suitable position within the batten for the PC board. We positioned our PC board so that three of the wires from the tube mounting tombstones reached the PC board terminals. The remaining wire was extended using the existing terminal block.

Drill holes to mount the PC board at the six mounting positions. You will also need to drill a hole in the side of the batten for the dimming potentiometer. The shaft on this potentiometer may need cutting down to size. Also drill and file a hole for the cordgrip grommet which can be positioned on the end of the batten or in the base.

Cover up any slots and holes on the underside of the batten base where the PC board will be located. We used Gaffer tape for this. Attach the PC board using M3 screws and nuts.

Make sure that the heatsinks on the PC board do not make contact with the batten top cover when it is fitted otherwise the fuse will blow.

Follow the diagram of Fig.7 which shows how to connect the batten wiring to the PC board. Do not forget the earth wire which connects between the batten case earth and the negative terminal on the PC board. Secure the 12V power leads with a cordgrip grommet.

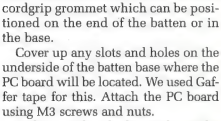


Fig.8: connect this circuit in series with the inverter if you want to check the operating current.

Testing

The fluorescent inverter circuit generates high voltages which can give you an electric shock. Take care when taking measurements and disconnect the 12V battery before touching any part of the circuit.

With 12V applied and without the fluorescent tube installed, check that there is about 334V DC between the metal tab of Q3 and ground. This voltage should be within 5% of 334V, between 317V and 350V.

How to run an 18W tube

As night follows day, we know that people will soon be asking us how to run this circuit with different sizes of fluorescent tube. Well at least we can forestall one of the queries – how to run an 18W tube.

The changes required are simple: Increase the turns on each half of the split inductor for L2 up to 50 (total of 100) and increase the 1.2Ω current sensing resistor to 2.2Ω.

These changes will also have the effect of making the dimming control more effective.

Now disconnect 12V, insert the tube and reapply 12V. Check that the tube starts within a few seconds. The circuit may make several attempts before the tube lights, particularly in cold weather.

As with all fluorescent lights, the tube will not reach full brightness until after five minutes or so and during this time the tube may exhibit a series of darker bands (striations) along its length. These will disappear once the tube has warmed up fully. The bands will be more noticeable if the dimming control is set to minimum brightness.

With the fluorescent tube driven to full brightness the current drain is around 3.7A at 12V. This means that some 45W is drawn from the battery and so the fluorescent tube drive will be a little less due to losses in the inverter. This is similar to the standard mains fluorescent drive circuitry which uses an iron-cored ballast (inductor) to limit tube current.

If you wish to check the tube current, use the circuit of Fig.8. This is connected in series with the positive supply to the inverter PC board and uses a 0.1Ω 5W resistor as a current shunt. The 22kΩ resistor and 100nF capacitor filter the current drawn from the battery so that the multimeter will be able to read the average current.

The current drawn from the battery is the voltage measured divided by 0.1. For 3.7A, the reading will be 370mV across the 100nF capacitor. Note that this current will only be reached after the tube has been lit for a few minutes.

When fully dimmed, the current will be around 3A or 300mV across the 100nF capacitor.

If the current is substantially different to these two values, check the battery voltage. It should be around 12.3V or more when driving the fluorescent inverter circuit. If it is below 12V, the battery will require charging. Also check that the 1mm gap is present between the core halves of L2. Then check the number of turns.

If these are correct add more turns to the inductor if the current is too high and remove turns if the current is too low. Remember that it is the impedance of L2 in conjunction with the drive frequency from IC3 which set the overall circuit operating conditions.

During operation, the heatsinks for Q1 and Q2 will run warm – and the transformer core for T1 will also run warm. Q2's heatsink will also be slightly warmer than that for Q1 since it is close to the heat from T1.

Inductors L1 and L2 will not be noticeably hotter than the ambient temperature. **SC**

SPYWARE – an update

In the June 2002 issue of SILICON CHIP we presented a feature on computer security – keeping out the bad guys (hackers) with a firewall. On the last page of that feature was a panel which mentioned "spyware" – programs which, as their name suggests, spy on your computer operation and send valuable information about you to marketing organisations, which then return the favour by spamming you with "special offers".

Spyware is insidious. While there are many invasions of your privacy these days, in most cases you can do something about them. At least most don't cost *you* money. But once your computer is infected with spyware, you probably won't even be aware that you are being spied on. And it does cost you actual dollars!

All this came home to me recently when at a mate's place. Knowing I "have something to do with computers"(!) he made the comment to me that he was going to have to buy a new computer for the kids because the current one was just too old, too slow.

I asked him what it was "A Pentium II 600," he replied. "What?" I said. "That's still a quite powerful machine even by today's standards," (the current top-of-the-line machines are 2+GHz.) I told him SILICON CHIP is produced on 600MHz Pentium II machines!

"Well, look at this," he said. He powered the computer up – which, I noted, took much longer than I would have expected. Even the virus checker seemed to bog down – without finding anything. I glanced at the taskbar and there were three or four applications running that probably didn't need to be there. But then he tried to log onto the internet via Optusnet.

From clicking "connect" (ie, starting the dial-out procedure) to being able to do anything on Optusnet's home page took about four minutes. I had to agree, that was very slow. But in the meantime the modem was going mad. Bulk data was moving somewhere! And once on, logging on to any new pages or sites seemed also painfully slow. I asked him if he wanted it fixed.

Is the Pope a Catholic?

First thing I did was had a look at the hard disk – a good size, 10GB, but almost full (just a couple of hundred megabytes free). But there was nothing obvious taking up such bulk space.

So I then searched for any .tmp files which had been left behind. <start-search for files or folders-*.tmp> There were only a "few" – 583 to be exact, totalling almost 1GB.

It didn't take long to delete all those, then I started asking questions. The computer was used by three teenage children. "How do you turn the computer off?" I asked, The two older girls said "by using start/shutdown". The boy was unusually quiet – but one of the girls dobbed him in. "He just switches it off at the power point. We've tried to tell him that's wrong but he won't listen".

I hope he'll listen now!

Then it was time to tackle the slow internet connection. I downloaded Adaware (from **www.lavasoftusa.com**) and then ran it. 258 suspect files found! While Adaware was deleting them for me, it was back to the kids. Again No 2 daughter spilled the beans on her brother. "He downloads anything and everything off the net. You name it, he downloads it".

Now this kid is a real menace (they should have called him Dennis). If it can be blown up, crashed, broken, dismantled . . . he'll do it. The best time the family had was when he broke his arm and was in plaster for eight weeks. He's that sort of kid.

I tried, as calmly as I could, to explain the dangers of downloading stuff from the net. "Unless the source is trusted, you're likely to get all sorts of things invading your computer," I said. "I'll bet you get dozens of spam emails a day."

"Oh, sometimes its hundreds," said No 2 daughter. "Is that why we keep getting ads for porn sites and casinos popping up?" asked No 1 daughter.

"Porn?" asked mate's wife, now showing obvious concern at what her kids were being subjected to. "Can't you stop that happening?"

I showed them how to block senders in Outlook Express but informed them that this wouldn't stop all the spammers. "Now they have your email addresses, you're targeted. They change their names, often just slightly, almost every day, so your blocking filter won't catch them.

"Look, I've been caught too." I explained how the other day I had a spam email come through similar to one I'd previously blocked. When I examined its properties, included were the words "bounce" and "block filter". The spam factory knew that I had blocked their email and had bounced it, so it was automatically assigned a new name to get through. They are that determined.

And only yesterday I discovered

yet another spin on spam. I received yet another unbelievably generous offer of something-or-other I didn't want from the good ol' USA. Not only *would* I never take advantage of the offer, I *could* never take advantage of it because it was "open to residents of the USA and Canada only" (they're really clever, these Yanks, spamming the whole world with useless garbage applicable to America only!).

But when I tried to block it, I found that they had put ***my*** email address in it as their own source address. So there was nothing I could block! As I said, spammers are determined.

So we looked at the spam and put blocks on as many domains and addresses as we could – at least that will slow the spammers down a little. Then I removed some of those programs from the startup menu that were clogging up the works.

Finally, I used a handy shareware utility called treesize.pro which gives a graphical and detailed report on what is taking up the space on the hard disk. Sure enough, most of it was his downloaded games (among other things!). And in many instances, multiple installations of the same game in different directories.

It didn't take long to uninstall (where required) through the control panel and delete multiple installs. Finally, I rebooted the machine.

I was happy to find that it booted significantly faster and even happier to note that instead of the several minutes that it took to log onto the net, it was now only about 20 seconds including the dial-out.

My mate was impressed, I have to say. No need for that new computer!

Once again, I tried to explain how to use the 'net and, more importantly, what not to do. But I'm fairly certain the kid wasn't listening. He was more interested in the fact that I'd cleaned out hard disk space.

There was this gleam in his eye and I'm sure he was thinking about what he could download into that 5GB when I had gone. . . **SC**

What should YOU do about spam?

Spammers cost YOU money. Every time you receive an unwanted email, you are paying for the download – in time, in your download allowance, etc. Do something about it. There's a rather ungenteel acronym: "GOYA" (the first three words are *get off yer . . .*). Well, do it! Spammers won't be stopped unless enough people act.

(a) NEVER NEVER NEVER take advantage of the spammer's most generous offer to remove or unsubscribe you from their list. All that does is confirm that your email address is correct and that you are reading your emails. You'll be bombarded with more spam.

(b) Apply a block to the spammer's URL if it is one of the generic spammers (ie, someone@spammer's name.com). Don't simply apply the block to the spammer's email address because they will simply change some part of their email address to get past your block.

If the spammer is, say, someone@hotmail.com or one of the other public email organisations, block the email address and not the URL otherwise you won't get any more emails from anyone else using that service!

If you're using Outlook Express (the world's most-used email program) you'll find the block filter under MESSAGE – BLOCK SENDER. You can also apply a block to newsgroups to block those pests who like the look of their own name in print and continually fill up newsgroups with garbage, much of which could be defamatory if they weren't hiding behind aliases!

Incidentally, most public email services such as Hotmail have their own spam blockers built it. Use them!

(c) Complain, complain, complain. Some of Australia's largest ISPs are also some of the world's worst when it comes to spamming. You and I have to continually bombard them with the only thing they understand – lots of email messages to their complaints department, about them not filtering out spam.

Many will simply ignore these emails but if enough people start sending enough complaint emails, it will start costing them money by clogging up their systems. ***Then*** they might then sit up and take notice.

(d) Complain to your local member of Parliament and to the Minister for Telecommunications. Governments do have the power to do something about spammers; like most things though they need a bit of a kick along to get them to do anything.

(e) Change email servers or even ISPs – and tell the old one why you are changing. Nothing speaks louder than lost revenue.

(f) Join one of the anti-spam organisations. Google "spam block" or similar and you'll find several organisations who are fighting the fight against the spammers. Help them to help you!

SERVICEMAN'S LOG

Notebook screen prices will crack you up!

Notebook computers that are more than a few years old generally aren't worth repairing, especially if the LCD screen is cracked. Recently, however, I was "trapped" into repairing two such machines.

I don't get involved in computer repairs all that often. That's because, by the time a computer gets to me, it simply isn't worth repairing. However, that rule doesn't always apply, especially if the computers aren't your standard desktop models.

Which brings me to the notebook saga. In the last few weeks, I had not one but two notebook computers lob in with exactly the same fault: dead screens.

Well, to be truthful, they weren't entirely dead. I could see that a small portion of the left side of each of them was working but that was all. And the reason was clear – both had full-length cracks running top to bottom on the LCD panel. Once that happens to the LCD, it's history.

As with (I believe) pretty-well all notebooks, it's easy to plug in a standard VGA monitor and operate them that way. But while this might prove that everything else is still kosher, lugging around a monitor somewhat defeats the purpose of owning a notebook!

Both machines were of the early Pentium (well, early compared to today's speedhogs) genus. One was an IBM 600Z, a 300MHz machine, while the other was an NEC 2650CDT, a 166MHz model. The question was, with the price of notebooks haven fallen so far in the last couple of years, would these be an economic repair?

LUGGING AROUND A MONITOR SOMEWHAT DEFEATS THE PURPOSE OF OWNING A NOTEBOOK

The IBM belonged to Mrs Brien. Or, to be more exact, it belonged to the organisation for whom she was the voluntary secretary. It's an organisation I'm also involved with, so this repair was to be basically a love job.

I think she was at least a little embarrassed at having broken the organisation's toy (by leaning on the screen) and wanted to fix it herself, rather than going through channels. She had already been to a repair agent and nearly died at the quote for the repair.

Swallowing her pride, she came to me almost in desperation; could I do it cheaper, on the quiet? She would pay for it herself, rather than facing the wrath of the President and the committee. She was willing to spend a modest amount, say $300 or so, rather than fork out the almost $1000 she'd been quoted.

The second machine, the NEC, came to me as "payment" for another job. Of course, I would have preferred coin of the realm but without wanting to go into the circumstances, I figured I was lucky to get the notebook, cracked screen notwithstanding.

It was fairly well tricked-up for a machine of its type – extra memory, a selection of PC cards (once known as PCMCIA cards) and even some original software, with manuals.

I reckon the NEC would have set the original owner back at least $5000, if not more. If I could get it working for a modest sum, I would have a nice little machine to play with. Maybe a bit slow by today's standards, but nice.

As I mentioned, Mrs Brien had already had a quote for repairing the IBM. I thought I might as well try the same thing with the NEC.

No go, from the genuine sources. They didn't keep new screens for a notebook this old (1998, mind you!).

What about secondhand? "We have them from time to time but haven't seen a 2650 screen in many months." "Any ideas," I asked? "They're not worth repairing. Why don't you buy a new machine . . ."

It wasn't exactly the news I wanted to hear.

My next thought was to try the 'net. There are several places, especially in the USA, that specialise in notebook screens, mainly secondhand, through dismantling. They at least came with a guarantee even if they were on the other side of the planet.

Late one night, when Mrs Serviceman had finished playing Solitaire, I logged on to the 'net and typed "notebook screens" into Google (what a great search engine!).

Sure enough, at least a dozen possible sources emerged – as expected, all in the USA. But the prices they were asking were something else again: $US300, $US400 and more – and remember, these had to be doubled for our little Aussie bleeder. And then I had to get them here and in one piece.

Scratch that idea. Neither Mrs Brien nor I were willing to outlay that amount of money.

What next, then? Did we both now own basically fairly useless (ie, old, slow) pseudo-desktop computers? And did I have to give Mrs Brien the news that she'd have to front El Presidenté and 'fess up?

What about Ebay?

And then I had another brainwave. What about Ebay? For the uninitiated, Ebay is the world's largest on-line auction and has an Australian site. Maybe I could pick up a couple of cheap, preferably dud, notebooks which still had intact screens?

So I logged onto Ebay and . . . nothing! Searching for the particular model numbers yielded not a skerrick, even though there were notebooks-a-plenty. I called Mrs Brien and gave her the two lots of bad news. She took it very well and said that she appreciated my efforts – and to hang on to it, if I was willing to persevere . . . something might come up.

Well, something did come up. A couple of days later I was on Ebay again and there was an organisation offering refurbished IBM notebooks – not Mrs Brien's model number but close to it. And the bids were reasonably low (around $300), even with just a few hours to go.

This was one auction where the seller was happy to identify themselves – and even give a phone number. So I rang the company, (Cost Plus Computers in Melbourne) and asked for their technical department.

The lady asked me what I needed and I told her I was willing to buy one of the IBM computers on Ebay if the screen was compatible with the 600Z. "No," she said, "they aren't".

As they say in the Toyota advert, "bugger!"

But then she said "hang on a sec, I'll check with our tech – we might have screens to suit." Just a few seconds later she was back. "Yes, we have some of those screens. $270 including postage. Did I want one?".

It arrived the very next day, very securely packaged and protected. Fitting the screen was almost an anticlimax – about 10 minutes very simple work. I had read a number of warnings on the US websites about the potential (pardon the pun) for a nasty, possibly lethal, belt from the fluorescent tube inverter used in these machines (even when turned off) so I was very wary to use my best HT practices when handling this area (one hand only, rubber mat, insulated tools, etc, etc).

But it was basically just a matter of undoing a few screws, unplugging the old screen and removing it, putting in the new and doing up the screws again.

Fingers crossed, I turned the computer on and. . . Bewdy! I rang Mrs Brien and she was around in a flash!

Now for the NEC

OK, that was the IBM. How about the NEC. A few days later, I again logged onto Ebay. And sure enough, no 2650's – but there was a "case and LCD screen, no mobo (motherboard)" being sold from, wait for it, Darwin! I checked NEC's website: the one being offered was a newer, faster machine but otherwise had fairly similar specs to my 2650, same screen type (TFT), resolution (800 x 600) and size . . . dare I risk it? Hey, what did I have to lose?

I rationalised to myself that if it didn't work, I'd put the whole lot back on Ebay and hopefully recover most, if not all, of my costs. So I bid for the lot and, after a short bidding war with someone else who obviously wanted it almost as much as me, eventually bought it for the princely sum of $108.00. If this worked, I was laughing!

After a day or so, the lady in Darwin who was selling the lot emailed me with her details. I rang her and arranged a direct deposit, along with instructions to package it up very carefully. I also arranged through a mate who works for a freight company for it to be picked up.

It arrived less than 24 hours later – not bad from Darwin, I thought. Hopefully, everything else would go as smoothly.

Rule No.1: don't tempt Murphy.

Of course, it didn't go smoothly. Getting the NEC apart proved to be a lot more difficult than the IBM. There is obviously a right way and a wrong way to do it and I chose what must have been the wrong way. There are

Items Covered This Month

- IBM 600Z notebook computer.
- NEC 2650CDT notebook computer.
- NEC N4853 (48cm) TV set.
- Metz Kreta VT Stereo 7949 Ch 687G TV set.

hidden screws, there are keyways, and there are various bits to remove in the right order. I made a mental note of these as I disassembled it.

Finally, I was at the stage where I could unscrew and unplug the cracked display. I compared this and the new one and my initial observations were positive. The plugs and sockets on both were identical, as was the overall size. That's a good sign. The bad sign was that the mounting screw locations were different – not much mind you, but different enough.

Even so, I managed to get a couple of screws into the mounting holes to hold it (just enough!) in place. There was little point in reassembling the case if it didn't work so I rechecked all the connections and gingerly turned it on.

Oh, happy day! I have never been so glad to see the Windows logon, complete and in beautiful living colour! I checked the basic operation of the machine and then turned it off, ready for final reassembly.

Of course, my mental notes were now nowhere to be found (perhaps I had powered down my brain without hitting <control-s> first?) but I did finally work out which bit went where.

One problem was that the screen was in a slightly different position and the left edge was hidden by the front of the case. So I had to move the display over a few millimetres (not easy!). Another problem was that I must have damaged some of the retaining lugs getting the front off the display because it no longer stayed locked to the back.

I hate to admit to such a blue-and-white striped apron approach but a tiny dollop of super-glue cured that problem (I hope I don't need to get it apart again!).

In use, about the only difference I've noticed between the old and new screens is a lot less brightness control. But where it's set is more than adequate for me. And just to prove the point, I've written this on it!

So with a bit of perseverance, a bit of a gamble and finally (for me!) some good luck, I was able to get both notebooks working again for not too much money.

Mrs Lawrence's NEC TV set

Mrs Lawrence was having problems with her 8-year old NEC TV set. This was a 1994 model N4853 (48cm) set which used a Thai-built MM-1 chassis and PWC-3850A PC board. She complained initially that the colour went all pink, then the set intermittently wouldn't start and now it was finally dead.

I advised her that it was better – not to mention cheaper – to bring the set to the workshop rather than vice versa. Alternatively, I could pick it up for a modest fee but she opted to get her son to drop it in.

When I removed the back on the workshop bench, I really couldn't imagine that it was going to be very difficult to fix. The set was, to all intents and purposes, dead but the switchmode power supply was working and supplying healthy voltages on both the high and low output rails. I didn't have a service manual but I did have a poorly photocopied circuit, with no voltages marked on it. Based on similar circuits, I guessed that the two voltage rails should be at about 115V and 20V respectively and this turned out to be pretty well spot on.

There was 115V on the collector of the horizontal output transistor (Q902) and also on the horizontal driver Q901. And that meant that there was no horizontal drive from pin 37 of the jungle IC201 (TDA8362).

I checked the crystal for faulty joints before measuring the supply voltage to pin 34 of IC201. This showed that there was no worthwhile voltage to power up the oscillator. Normally, the supply voltage is derived from Q106's emitter and this transistor has its collector connected to the 20V rail via R194. Q104's base is controlled by Q105 and pin 31 of IC101 (an M37-210M3 microprocessor), to power the set up from stand-by. The problem was that Q104 wasn't being controlled.

I checked and replaced Q2001 and Q2002 as a matter of course. They are part of the EHT/x-ray protection circuit from pin 2 of the horizontal output transformer and they can give trouble. Microprocessor faults can be ticklish and expensive to fix, so the trick is to concentrate on the easy and cheap solutions first.

I started by measuring the +5V rail (Vcc) to pin 27, which was correct. I then measured the reset voltage at pin 30, which was very low. This is derived from the collector of Q104 via R192. There was 8V applied to the emitter of Q104 but only 4V or so at the collector. Similarly, the base of Q104 was low.

This looked straightforward. It could really only be the transistor, R191, zener diode ZD101 (7.5V) or a load that was causing these voltages to be so low. Sometimes it's just quicker to replace parts rather than measure them so I changed the transistor and R191 (47kΩ) but neither made any difference.

I didn't have a 7.5V zener diode in stock for ZD101, so I thought I'd give

it the best test I could devise. I removed it and connected it to my power supply, which is current and voltage controlled. With the cathode connected to the positive and the current set to nearly minimum (this is only a 0.5W device), I turned the voltage up. When the current meter was just on the verge of reading, I checked the voltage – it was spot on at 7.5V. In my book, that meant that the zener was working properly. The only problem was that back in the real world (ie, in the circuit), it wasn't.

I resolved the problem a day later when my stock of 7.5V zeners was replenished. I popped in a new one and this part of the job was fixed.

Now I had a picture but it was indeed pink, which meant there was no green. I examined the CRT socket board and could see it was full of doubtful joints. Resoldering R908 restored the missing primary colours.

I put it aside to soak test and noticed that, after a while, the purity was wrong. I degaussed the screen and put it down to someone carrying a magnet near the set. The next day I switched the set on and it went "bang" in an embarrassingly loud way. Back it went onto the bench.

One problem with this set is when the back is removed, the PC board sticks to the rear half of the shell but the leads to the speaker and degaussing coils, etc are still connected to the front half of the shell and the tube, causing stress on the connections.

In this case, though, the set was dead because the dual posistor (PTC) had died and taken the fuse with it. A new one soon fixed this but after I had put the back on again and tried it, there was even more trouble. There was now no sound, so it all had to come out again. The ridiculously short loudspeaker leads had finally been pulled too hard and broken in two places, one at the loudspeaker and one at the PC board socket connection.

Change in attitudes

Readers who have been reading this column for a long time will have noticed how customer's attitudes have changed over the years.

Technology has become so complex and yet, at the same time, so cheap. This double whammy really means we no longer have the luxury of fitting an exact cause to an effect; one just has to accept that this is just the way it is and move on. Customers are now more demanding than ever before, expecting more for their money and being fully aware of their rights.

In the black and white TV days, we would have been happy if a TV set had only broken down three times a year. Now we are bitterly disappointed if a colour TV set breaks down once in three years and this is despite it being at least a fourfold leap in complexity, technology and performance – all at a fraction of the cost of black and white TV sets.

Repair methods are changing too, with some of the emphasis now on software monitoring – either that, or immediate disposal. Very few new VCRs are worth repairing now, the only exceptions being hifi and Super VHS models. Many DVD players are also uneconomical to repair and small 34cm TV sets have become "throwaway" items.

More importantly, installation of new equipment is becoming a growth area. New equipment generally is now so much more complex to install and the setting up methods can vary widely from one brand to another. Indeed, some equipment can take an enormous amount of time to set up, often due to its complexity but sometimes because the setting-up method is cumbersome.

For example, to skip all the unused program sites on some Panasonic VCRs, it can take up to four separate commands to navigate through 100 programs. Many people just opt for the auto installation, which invariably means the channels don't correspond with the numbers on the remote control.

Another drama is digital TV co-channel interference with the VCR and working out how to turn off the RF output (if available) and use only AV leads.

I heard of a case recently involving the installation a European TV set. To do this, it is necessary to get into a menu, and the first question is, naturally, "What language do you want to read?" After selecting "English", it asks

which country you reside in. Easy, you say? The problem was that Australia (CCIR system B/G) wasn't offered as an option and selecting either Germany or Britain didn't help much.

In the end, the technician used a variety of different countries to tune in the Band I, Band III and UHF channels. He did this on a channel-by-channel basis until he had them all in. Madagascar was used for Australia's channel 2!

I suspect there was probably an easier way but he reckoned he couldn't find it in either the instruction book or the on-screen help. And have you noticed how thick some of these instruction books are now? There just isn't time to read through one on a home service call – but the customer expects me to know everything about it!

Metz stereo TV set

Getting back to the bench, I had an interesting set brought in recently. It was a Metz, made in Germany. More exactly, it was a Metz Kreta VT Stereo 7949 Ch 687G with a 66cm tube – about 10 years old, I think. It was one of the first of this brand I had seen and it came in with the complaint of no picture.

The fault wasn't difficult to diagnose. The tripler had been arcing and had died. The replacement took a while to get from overseas and it wasn't cheap but I thought that would be that. As usual, it wasn't – I still had no picture.

First, I checked the EHT. This was OK at 29.5kV and I could see that the CRT filaments were alight (I measured 6.3V across them). The screen voltage (VG2) varied from 400-1000V, the HT was correct at +163V and there was 210V applied to the CRT base. In addition, there was +12V on the first grid of the tube.

I then tried my dangerous and totally inadvisable trick of momentarily shorting a CRT cathode (any colour) to chassis and observing the screen. (This is particularly dangerous on a set like this with complex push-pull automatic greyscale tracking video amplifiers.) Despite this, the result on the screen brought good and bad news. It was good news because the screen was full and the vertical deflection was working. On the other hand, it was bad news, because it was a dull greyish raster no matter what colour I shorted.

I was expecting an intensely coloured raster at least.

The only thing I hadn't checked was the CRT focus circuit where I would expect the focus potential to be about 4.5kV. Checking this was difficult because the 4.5kV cable from the tripler is very effectively insulated right up to and over the focus pin base on the socket. I overcame this by using a single strand of very fine gauge wire which I managed to wrap around the focus pin on the CRT, before replacing the CRT socket. I attached the other end to my EHT meter.

"Dodgy" is the best word to describe all this. What's more, my homemade EHT meter is 10µA fsd (1kΩ resistance) and is fed via 2 x 130MΩ resistors, so it would still create some loading on this supply. Other problems involved insulation, sparking and residual charges. Anyway, my makeshift "focus meter" read zero volts.

I disconnected the tripler wire from the CRT focus pin and connected the EHT meter to this lead. This time I was cooking with gas – now I did have 4.5kV. So how was it being pulled down when it was connected to the tube? With the socket off the tube neck, I checked the resistance between the focus pin and chassis. It measured completely open circuit with my best ohmmeter on the x100kΩ/volt range. But this was a low voltage test and did not necessarily tell the true story.

Normally, I would have simply fitted another CRT socket but this one was unusual and quite small; smaller than anything likely to be available locally. And the customer was getting tetchy about the time since the job started, so ordering a new one from Germany wasn't really an option.

Using a pair of sidecutters, I hacked my way into the focus spark gap housing to have a sticky beak. Fortunately, this revealed that all the inside was a mass of black carbon – it was like a bomb had exploded inside. Obviously, it had been sparking severely. I cleaned out the carbon as best I could, removed the chassis half of the spark gap, filled it all with silicone rubber and let it set.

Late the next day, I switched the set on and the picture, after slight adjustments, was now perfect. My theory, for what it is worth, is that an insect probably crawled into the spark gap and caused the sparking. Gradually, as it became carbonised, the current drawn became excessive, causing the tripler to overheat, crack its insulation and finally fail. **SC**

Jaycar ELECTRONICS

SEPTEMBER SALE

Video Doorphone

NEW PRODUCT

This modern, slimline video intercom system will let you identify callers without them knowing. The external unit features a black and white CMOS camera with Infra Red illumination to see in the dark. The internal unit houses a 4" monitor, the handset, and control buttons. Can control electronic door strikes, (LA-5078) and can connect up to 2 extra receivers /monitors.

Cat. QC-3413 $299.50

Extra Receiver Available
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Made in Japan, this superior gas soldering iron is compact, easy to handle and doubles as a hot blower and flame torch. A small tank window lets you to see how much gas remains in the tank. Supplied with protective cap with pocket clip, 1mm soldering iron tip, hot blow tip and instructions. Ignite using a cigarette lighter or similar.

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Cat. AR-1815 $199

Extra Receiver Units Available
Cat. AR-1816 $109.50

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With the ability to analyse and store information on your home or notebook computer, this meter is ideally suited to laboratory or field work. Features include 30min Auto Power off & Relative Measurements, which allows a value to be stored into the meter's memory, then compared to a new data value. Includes protective rubber holster, RS232 cable, temperature probe as well as standard probes. See Cat Pg. 182 for full details and specs.

Cat. QM-1538 $69.95

Recordable Media from Laser!

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Cat. XC-4725 $1.35ea

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Cat. XM-5126 $39.95

7 LED Ultra Bright Head Light

This ultra bright headlight features three different modes of illumination, ranging between 1, 3 and 7 LED operation. It has an adjustable head strap for hands free use, with vertical angle adjustment, and a water resistant housing.

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Cat. ST-3073 $64.95

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NEW PRODUCT

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Cat. MI-5090 $1099

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NEW PRODUCT

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NEW PRODUCT

This stereo mixer features removable cross-fade slide control, LED VU meters, dedicated gain controls for each channel, cue level and mixing controls. Accepts both phono and line level inputs. Features mains power and line level outputs. See Cat Pg 241.

Cat. AM-4210 $99

Digital Rain Gauge

NEW PRODUCT

This meter shows two separate displays of measured rainfall, plus accrued data reading. Rainfall collector is connected via a 10 metre cable. Either display can be reset any time. See Cat. Pg. 327.

Cat. XC-0300 $79.95

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NEW PRODUCT

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Cat. AA-2001 $8.95ea

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NEW PRODUCT

Cat. AM-4205 $99

Wireless Digital Rain Gauge with Thermometer

NEW PRODUCT

A combined rainfall meter and indoor thermometer, which requires no wiring or mains power. The rainfall collection well transmits data to the digital display. See Cat. Pg. 327

Cat. XC-0305 $119

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Cat. XC-4836
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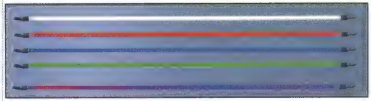

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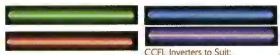


New Technology

CCFL Inverters to Suit:
100mm Cat. SL-2868 $9.95ea
300mm Cat. SL-2888 $12.95ea

OVERNIGHT DELIVERY AVAILABLE*

1800 022 888

Can't make it to one of our stores - then let our store come to you!

www.jaycar.com.au

Surveillance Deal

Buy a complete surveillance system from Jaycar Electronics and you will now save money. There are 2 discount levels available depending on the size of the system purchased.

•LEVEL 1
Spend $700* (with discount) and we will supply the equipment needed at our 1st catalogue quantity purchase price break. **This saves you up to 10%.**

•LEVEL 2
Spend $1200* (with discount) and you move to the 2nd catalogue quantity purchase price break.
This saves you up to 20%.

•The $700 and $1200 figures are after the discount has been applied. IE goods total before discount would be around $800 and $1350. Goods included in the deal are: cameras, lenses, power supplies, processors, monitors, brackets and cables.

A time lapse VCR, digital video recorder and our 16 channel multiplexer can be added to the deal!

Pan/Tilt/Speed Dome Store Display Sellout!

Units are display models. All are in good working order with 12 months warranty.

Pan/Tilt B&W Speed Dome Camera with Audio
Was $449 Save $120
Cat. QC-3210 **Now $329**

Pan/Tilt Colour Speed Dome Camera with Audio
Was $739 Save $240
Cat. QC-3215 **Now $499**

4 Channel Pan/Tilt Controller for Speed Domes
Was $199 Save $50
Cat. QC-3200 **Now $149**

Panning Camera Base
Make your surveillance more efficient and cover more area with the one camera.
Was $179 Save $50
Cat. QC-3206 **Now $129**

Controller for Panning Camera Base
Was $89 Save $30
Cat. QC-3202 **Now $69**

Quantities strictly limited call stores first

960Hr Time Lapse VCR

This brilliant machine will record up to 960HRS onto one E-180 tape. Recording times can be set to different lengths, and can be triggered by PIR's, alarm panels and others. More than one machine can be linked together to record sequentially. At the end of the tape, the recorder can be set to automatically rewind, and record over the previous recording, or to simply eject.

NEW PRODUCT

•Up to 960HR record time.
•Four Head Helical Scan Azimuth System

Cat. QV-3053 **$899**

24Hr Time Lapse Video Recorder

If you don't need the extra features of the 960HR Time Lapse VCR, then this model will do the trick.
Features include 24Hr Recording, High Resolution, and One Shot Recording (1,2,or 3 minute intervals). See Cat Pg 275 or ask in store for details.
Was $899 Save $100

Cat. QV-3050 **Now $799**

4 Channel Digital Surveillance Video Recorder DVR

NEW PRODUCT

40GB Hardrive Included

This Professional quality recorder features a 40GB removable Hard Disk Drive, external triggering, NTSC or PAL capability and password protection settings. The removable hard drive is compatible with our Cat. XC-4670 removable carrier, so the drive can be installed into a PC for further viewing and editing with the software provided. Contact our sales staff for further details.

Cat. QV-3060 **$1995**

Pro Aluminium External Camera Housing with 24V Heater

NEW PRODUCT

Adept this weatherproof enclosure to our Professional range of CCD cameras. It features an internal 24V heater to stop the housing humidifying which can cause clouding of the lens.

Cat. QC-3331 **$69.95**

Dome Style Colour CCD Camera

High quality colour CCD dome camera has 380 TV Line (512Horiz) Resolution and utilises a 1/4" Sony sensor chip. Auto white-balance and shutter speeds from 1/50 to 1/100,000 of a second. Requires a 12VDC regulated power supply. Use our MP3011-12VDC 300mA Regulated Adaptor

NEW PRODUCT

Cat. QC-3489 **$239**

Pinhole Colour CCD Camera in Metal Case with Audio

NEW PRODUCT

Uses a Sony CCD Image Sensor and can be hidden just about anywhere. This camera is ideal for surveillance use and can be hidden from view, as the pinhole lens only requires a 1mm-diameter hole for viewing. Audio is via an on board Electret microphone.

Cat. QC-3496 **$219**

B&W CCD Camera in Metal Case with Sony Sensor and Audio

Ultra low Lux sensor, down to 0.1 Lux
Was $169 Save $20

Cat. QC-3476 **$149**

Dome Style B&W CCD Camera

Samsung Image Sensor in a black dome cover.
Was $109 Save $10

Cat. QC-3472 **$99**

B&W Bullet Style CCD Camera

Weatherproof Aluminium Case.
Was $169 Save $20

Cat. QC-3467 **$149**

B&W CCD Camera in Metal Case with Audio

High Quality 1/3" Samsung Image Sensor.
Was $109 Save $10

Cat. QC-3474 **$99**

Dome Style Colour CCD Camera

Features an adjustable focus lens and black dome cover.
Was $239 Save $20

Cat. QC-3484 **$219**

Pinhole Colour CCD Camera in Metal Case with Audio

Requires just a 1mm viewing hole.
Was $219 Save $20

Cat. QC-3486 **$199**

Plugpack to Suit CCD Cameras

12VDC 300mA regulated plugpack for CCD Cameras.

Cat. MP-3011 **$24.95**

B&W CCD Pinhole Camera in Metal Case with Audio

Requires just a 1mm viewing hole.
Was $109 Save $10

Cat. QC-3475 **$99**

Infrared Light for CCD Cameras

Use this light to let your CCD camera see in the dark. Range approx. 5m. Requires 12.5-13.8V @ 300mA
Was $42.95 Save $5

Cat. AA-0290 **$37.95**

B&W CCD Camera with Infrared Illumination

IR Illumination for 0 Lux conditions and a Samsung Image Sensor.
Was $109 Save $10

Cat. QC-3468 **$99**

OVERNIGHT DELIVERY AVAILABLE*

Can't make it to one of our stores - then let our store come to you!

1800 022 888

www.jaycar.com.au

High Quality LED Torch with Dimming and Flashing Feature

This torch is microprocessor controlled with a flasher and dimmer circuit built in. It's powered by a 9V battery, has a stainless steel case, and a soft plastic handle. Made in Germany. Size 93(L) x 39(Dia).

NEW PRODUCT

Cat. ST-3330 $49.95

Outdoor UHF Hi/Lo/VHF Triplexer

Mounts directly onto the TV mast. Can be used as a triplexer for UHF Hi/Lo/VHF input or a diplexer for UHF/VHF and have one cable from the antenna to yor home. **Half the price!!!**

Cat. LT-3013 $7.50

eTREX Handheld GPS

The GARMIN eTrex is an entry level unit for outdoors enthusiasts. It features easy operation, strong performance and value for money. All information is accessible via the 5 side mount buttons, on a well presented, backlit LCD screen. Housed in a rugged water resistant case, the eTrex will go anywhere. Ask at your local Jaycar store for full details.

Cat. DC-1050 $349

CHECK THE GREAT PRICE

NEW PRODUCT

Sound Activated Baby Cot Light

This light is just the thing for anyone with a newborn baby, or child scared of the dark. The light can be sound activated. When your child starts crying at night, the light will automatically switch on, and stop you fumbling in the dark for a light switch when coming to their aid.

NEW PRODUCT

Cat. SP-3029 $19.95

Save on Duratech 240V Soldering Irons!

Fully approved, has a stainless steel barrel, and orange cool grip impact resistant handle.

25 Watt
Was $19.80 Save $4

Cat. TS-1465 $15.80

40 Watt
Was $27.95 Save $6

Cat. TS-1475 $21.95

80 Watt
Was $32.95 Save $8

Cat. TS-1485 $24.95

Secret UV Glow Pen

With this Write and Light UV glow pen, you can write notes and messages in secret. The pen uses an'Invisible Ink' which can only be seen under UV light. Simply write your message with the special pen, and when you need to read it, shine the small UV key ring torch onto the note and instantly your message appears. Ideal for leaving secret messages on post-it notes. Use coloured paper for best results.

NEW PRODUCT

Cat. ST-3089 $9.95

Soldering Station Deal

Buy this Goot Anti Static Temperature Controlled Soldering Station for $269.95

Cat. TS-1440

or

Programmable Digital LCD Display Soldering Station for $199

Cat. TS-1400

Get these free:

JAPANESE MADE

200g roll of Solder	Cat. NS-3005	Worth $6.95
Desolder Pump	Cat. TH-1860	Worth $11.25
Deluxe Tip cleaner	Cat. TS-1510	Worth $12.95

Press "N" Peel PCB Film

Simply photo-copy or laserprint your PCB artwork, cut to size, iron on, and etch! Simple. See Pg 108 for details.

Cat. HG-9980 $34.95

It's Back! Keyring Screwdriver Set

Small enough to fit on your keyring at only 55mm in length. They have a 5mm slotted and #2 Phillips driver.

Cat. TD-2012 $2.95

What a Flop!

We thought these would be a hit, but we were wrong! They feature input lockout shutters to stop your leads plugging to the wrong sockets. So grab a bargain on one of these meters! Fantastic specs - see 2002 catalogue. **Limited Quantity.**

Frequency DMM
2001 was $85 & 2002 was $65

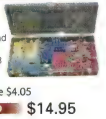
Cat. QM-1321 $49

Autoranging DMM
2001 was $79.95 & 2002 was $59.95

Cat. QM-1532 $49

Quick Connect Pack

Contains 160pieces of assorted connectors and crimp plugs. See Cat Pg 73 for what's inside!



Was $19 Save $4.05

Cat. PT-4530 $14.95

100W Soldering Gun

The tip can reach full temperature in seconds - great for fast jobs - with a maximum of 12 seconds on and a minimum of 48 seconds off. Trigger controlled and features a solder joint illuminator. 240V mains powered.
Was $29.95 Save $5

Cat. TS-1425 $24.95

Save on Rechargeable Ni-Mh Batteries - September Only

		Normally	Buy 4+	Buy 10+	Buy 20+
AAA 650mAh Nipple	Cat. SB-2444	**$3.59**	**$3.15ea**	**$2.75ea**	**$2.35ea**
AAA 650mAh Tags	Cat. SB-2446	**$3.78**	**$3.30ea**	**$2.95ea**	**$2.55ea**
AA 1650mAh Nipple	Cat. SB-1700	**$4.50**	**$3.95ea**	**$3.60ea**	**$3.20ea**
AA 1650mAh Tags	Cat. SB-1702	**$4.75**	**$4.15ea**	**$3.75ea**	**$3.35ea**
AA 1800mAh Nipple	Cat. SB-1705	**$5.95**	**$5.25ea**	**$4.75ea**	**$4.35ea**
Sub C 2700mAh Tags	Cat. SB-2447	**$8.95**	**$7.95ea**	**$7.45ea**	**$6.95ea**
C 4500mAh Nipple	Cat. SB-2429	**$14.95**	**$13.95ea**	**$11.70ea**	**$10.95ea**
D 8000mAh Nipple	Cat. SB-2449	**$24.90**	**$22.95ea**	**$21.95ea**	**$20.95ea**
9V (8.4V) 200Ah	Cat. SB-2467	**$14.95**	**Sept. Only**	**$12.95ea**	**Buy 10+ $10.95ea**
AA 1000mAh Nipple	Cat. SB-2455	**$3.35**	**$2.95ea**	**$2.60ea**	**$2.30ea**
AA 1000mAh Tags	Cat. SB-2457	**$3.59**	**$3.15ea**	**$2.75ea**	**$2.45ea**

4/5 A 1800mAH Ni-Mh Battery

Solder Tags Size 43(H) x 17(Dia)mm
Cat. SB-1718 $8.95ea

NEW PRODUCT

High Quality ConCord Audio Video Leads

3.5mm Stereo Plug to 2 x RCA Plugs

1.5m — Was $14.95 Save $3 — Cat. WB-7206 — $11.95

3.0m — Was $16.75 Save $3.80 — Cat. WB-7208 — $12.95

3 x RCA Plugs to 3 x RCA Plugs

1.5m — Was $29.95 Save $4 — Cat. WB-7234 — $25.95

3.0m — Was $34.95 Save $5 — Cat. WB-7236 — $29.95

Fibre Optic Toslink Cable

1.0m — Was $19.95 Save $4 — Cat. WQ-7260 — $25.95

2.0m — Was $27.95 Save $5 — Cat. WQ-7262 — $29.95

Scart Plug to 3 x RCA Plugs

1.5m — Was $29.95 Save $5 — Cat. WQ-7244 — $24.95

Party Speakers

Great Sound, at an Excellent Price. See Cat Pg 235 for details and specs. Techstore shoppers - get a quote on freight first. Price Per Unit

12" Party Speaker

Power Handling: 100WRMS
Was $159ea Save $15ea
Cat. CS-2512 — $144ea

15" Party Speaker

Power Handling: 120WRMS
Was $209ea Save $20ea
Cat. CS-2515 — $189ea

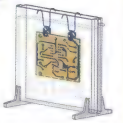
PCB Etching Tank

NEW PRODUCT

Make PCB Etching easy with this PCB Etching Tank Ideal for etching PCB's up to 200 x 250mm in size. The tank is thin, so it uses less solution to cover more area. Suitable for single or double sided PCB's. PCB Clips and hooks are provided, so inserting and removing your PCB's in the solution is easy. Supplied with stands which can be screwed to a bench for extra stability.

DUE EARLY SEPTEMBER

Cat. HP-9530 — $49.95



Mini Indoor Fogger

NEW PRODUCT

Just place the fogger in water and watch as clouds of condensed vapour float on the surface of the water and tumble over the sides of the container. Looks fantastic in a terrarium or fountain and adds a wondrous effect to flower arrangements.

Cat. YH-5420 — $59.95

Etch your own PC Boards Booklet

Need just one or two printed circuit boards, for a magazine project or a prototype for your latest design? It's not too hard to etch your own single-sided or even double-sided boards, especially if you have access to a photocopier, or a PC and laser printer. In this tech update we tell you all you need to know. 8 pages

NEW PRODUCT

Cat. BI-8212 — $2

Or FREE with the purchase of the PCB Etching Tank if you ask.

5 in 1 USB Card Reader / Writer + 2 Port USB Hub

This USB 5 in 1 card reader is a high performance device designed for accessing data from Compact flash cards, IBM micro drive, Secure Digital card(SD), Multimedia cards(MMC) and Smart media cards. Connects via USB port on both MAC or PC and also features a 2 port USB hub.

Cat. XC-4769 — $149.95

Illuminated Indoor Mini Fogger

This mini fogger has an inbuilt halogen lamp to brighten up your display and enhance the fogging effect. Suitable for a wide range of uses. Looks fantastic in a fountain and will turn an ordinary flower arrangement into a masterpiece. Fitted with a 12 volt 10 watt halogen globe. Measures approx 60 (W) x 39 (H) x 30 (D)mm. Plug pack and 1.8 metre cable supplied.

NEW PRODUCT

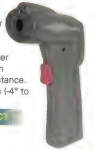
Cat. YH-5425 — $79.95

Non-Contact Digital Thermometer with Laser Sighting

This hand held infrared thermometer quickly takes the surface temperature of any object and, for more remote objects, the built-in laser pointer can be activated to ensure an accurate, on-sight reading from a distance. Temp range is -20° to +270° Celsius (-4° to 518° farenheight).

NEW PRODUCT

Cat. QM-7220 — $149.50



Laser 4.7Gb DVD-R

For General Use

Complies with DVD-R for general spec, version 2.0
•For recording in PC applications (data/video)
•For use in drives and recorders that support DVD-R discs
Was $7.95 Save $1

Cat. XC-4721 — Now $6.95

LED Illuminated Whistles

Translucent barrel glows with light and can be selected to flash at the touch of a button. Three Colours Available
Red: Cat. ST-3094 Green: Cat. ST-3094
Blue: Cat. ST-3095

Were $11.95 Save $4

All colours now $7.95ea

Sensational Koss Headphone Deal

Normally KOSS (US Made) Headphones are very expensive. Not in this case, as we have purchased the remainder of a production run for Ford Motor Co. USA. They are lightweight with adjustable headband. Note that there are two headphones and two 6.5/3.5mm adaptors (PA3586) in the deal. Excellent value for money.

Was $39.95 Save $5

Cat. AA-2046 — $34.95

Laser 4.7Gb DVD-RW

•Complies with DVD-RW specifications, version 1.1
•For use in drives and recorders that support DVD-RW discs
Was $12.95 Save $1

Cat. XC-4722 — Now $11.95

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Full Feature EQUATOR Car Alarm, Free Car Battery Charger!

This alarm has all the necessary protection for your car, featuring code hopping remotes, immobiliser, central locking control, backup battery siren, and a flashing warning light. And if that is not enough, this month only, we will give you a 4Amp Car Battery Charger (MB-3520) valued at $39.95, absolutely FREE! See Cat Pg. 154 and 132 for specifications.

Cat. LA-8955 $199

12VDC 130WRMS Car Sub Amp Module

Accepts line level inputs, and delivers 130WRMS into 4Ohms or 165WRMS into 2Ω. Built in variable crossover and 180° phase switch.
Was $179 Save $40

Cat. AA-0514 Sept $139

12VDC 240WRMS Car Sub Amp Module

240WRMS into 4 Ohms or 290WRMS into 2Ω.. High and Line level inputs, variable crossover, three stage bass boost, level and phase controls.

Was $249 Save $40

Cat. AA-0513 Sept $209

High Power Audio Wiring Kit

This kit includes almost everything you need to set-up your sound system in your car. Suitable for systems around 100WRMS.

Was $44.95 Save $10

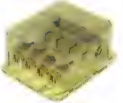
Cat. AA-0440 Now $34.95

70/100A Circuit Breaker For Cars 12/24V

Rugged and reliable devices suitable for car sound installations. Each device will trip within a few milliseconds under short circuit conditions, and feature protective rubber caps, test button and gold plated terminals.

70 Amp Cat SF-2265
100 Amp Cat SF-2266 $32.95ea

4 Way Platinum Fuse Box



This Platinum finish distribution block will accept 4G cable from one of three directions and feeds 4 independently fused 8G outputs. Designed to accept our new range of gold-plated maxi fuses and also includes compression fitting gold-plated cable termination.

Was $29.95 Save $6

Cat. SZ-2086 Now $23.95

USB Compact Flash and Smart Card Reader

Plug & Play compatible, featuring high speed transfer for Compact Flash and Smartmedia cards

Was $99.95 Save $15

Cat. XC-4770 $84.95

Fig 8 OFC Screened Audio Cable

High quality shielded cable for excellent reproduction.
- Inner Conductor: 0.12mm OFC.
- Insulator: FPE Red/White
- Shield: 14mm Aluminium foil, straight screen.
- 25 x 0.12mm strands

NEW PRODUCT

Cat. WB-1506 $3.25m

CD Cassette Adaptor

Connect your portable CD player or MD/MP3 player to your car's Cassette player.

Was $19.95 Save $5

Cat. AR-1760 Now $14.95

Save on Platinum Terminals and Fuse Blocks

3 Wire Platinum Battery Terminals

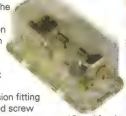
Accommodate one 4G and two 8G outputs. Cable termination is via gold-plated compression fittings.

Positive
Was $26.95 Save $5
Cat. HC-4050 Now $21.95

Negative
Was $26.95 Save $5
Cat. HC-4052 Now $21.95

Cover to Suit
Was $4.95 Save $1
Cat. HC-4053 Now $3.95

2 Way Platinum Fuse Box



Much the same as the 4-way distribution block with just two outputs. This block features compression fitting gold-plated screw connections and accepts 4G and feeds two 8G outputs via a maxi-blade fuse.

Was $19.95 Save $5

Cat. SZ-2084 $14.95

Liquid Electrical Tape/Thread Locker

Simply brush it on, and it will insulate, seal out moisture. Acid and salt resistant, won't crack or peel. See Cat Pg 110.

Black
Was $27.95 Save $3
Cat. NM-2832 $24.95

Red
Was $27.95 Save $3
Cat. NM-2834 $24.95

24 and 96 CD Carry Wallets

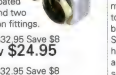
The compact way to carry your CD's. They feature non-scratch inserts, and a tough exterior with a zipper to close it up. Colours available are Red and Black.

NEW PRODUCTS

24CD
Cat. AR-1483 $5.95ea

96CD
Cat. AR-1484 $19.95ea

4 Wire Platinum Battery Terminals



This monster sized battery terminal is reserved for the car audio extremist with a bigger that average setup. The terminal is Platinum coated and has one 2G, one 4G and two 8G gold-plated compression fittings.

Positive
Was $32.95 Save $8
Cat. HC-4054 Now $24.95

Negative
Was $32.95 Save $8
Cat. HC-4056 Now $24.95

Cover to Suit
Was $6.95 Save $2
Cat. HC-4057 Now $4.95

Speaker Grill Clamp Kit

The easy way to mount grills to speaker boxes. Simply hook over the grill and use the plastic self tapping screws to secure. Ideal for carpeted sub boxes.

Pkt. 4
Cat. AX-3530 $1.95

Pk. 100
Cat. AX-3531 $19.95

Key Ring Laser Pointer

Fully approved laser pointer with <1mW output and powered by 3x LR44 button cells. Supplied with batteries and key-chain clip.

Was $12.95
Cat. ST-3102
Now $9.95

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www.jaycar.com.au

Wafer Card with PIC16F84A + 24LC16B Inbuilt

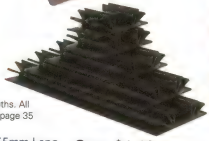
Popular with Smart Card programmers.

NEW PRODUCT

1+ $19.95
10+ $17.70
25+ $15.70

Cat. ZZ-8800

10% Off High Efficiency Fan Type Heatsinks



Available in various lengths. All 105mm wide. See Cat. page 35 for specifications.

Cat. HH-8570	55mm Long Was $4.95	Sept $4.46
Cat. HH-8572	75mm Long Was $8.95	Sept $8.06
Cat. HH-8573	135mm Long Was $9.95	Sept $8.96
Cat. HH-8574	225mm Long Was $19.75	Sept $17.78
Cat. HH-8578	300mm Long Was $24.75	Sept $22.28

Anti-static Desk and Floor Mats

Ground your workstation properly and reduce the risk of static shock which can destroy expensive components. Both have a grain texture for non slip. See Cat page 218 for details and grounding leads.

Large Anti-static Workplace Desk Mat
Measures 1m x 0.5m and is 3mm thick.

Cat. TH-1784 $44.95

Anti-static Floor Mat
Measures 2m x 1m and is 2mm thick.

Cat. TH-1785 $169

BUY BOTH TOGETHER FOR ONLY $190 SAVE $23.95

9-15VDC 15A Switchmode Bench Power Supply

Was $279 Save $30

Cat. MP-3085 Now $249

High Quality Electrical Shears with Pouch

Finely honed and serrated blades, for cutting insulation, spaghetti tubing, hook up wire etc.

Supplied with a heavy duty nylon belt pouch.
Was $27.95 Save $3

Cat. TH-1756 Now $24.95

Gold Speaker Stands

Solid metal and gold plated, they lift speakers off the floor to reduce resonances from the boxes. Height adjustable. See Cat Pg 238 for details.
Was $31.95 Save $5

Cat. HS-8000 Now $26.95

Sound Absorbing Acoustic Tiles

Need extra sound absorption for your studio or home theatre? These thick 38mm tiles are sure to do it. Sold as a pair. 300 x 300mm, 38mm thick. See P238 for more. Was $22.50pr Save $4.00pr

Cat. AX-3656 Now $18.50pr

$10 Off ABS Rack Mount Enclosures

Made of strong ABS plastic, they are supplied in knock-down form which can be assembled in seconds with no more than a screwdriver. All feature slots for cross flow ventilation, and standoffs to mount PCB's directly onto the covers.

Cat. HB-5135	1 unit (Beige) Was $49.95 Save $10	Now $39.95
Cat. HB-5145	2 unit (Beige) Was $59.95 Save $10	Now $49.95
Cat. HB-5160	3 unit (Beige) Was $69.95 Save $10	Now $59.95
Cat. HB-5140	1 unit (Black) Was $49.95 Save $10	Now $39.95
Cat. HB-5150	2 unit (Black) Was $59.95 Save $10	Now $49.95
Cat. HB-5155	3 unit (Black) Was $69.95 Save $10	Now $59.95

Professional Computer Toolkit

With a great selection of quality chrome vanadium tools, this kit is a must for every serious enthusiast and professional. See Cat Pg 217 for what's inside!
Was $78.95 Save $14

Cat. TD-2041 Now $64.95

50WRMS Faders (L-pads)

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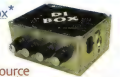

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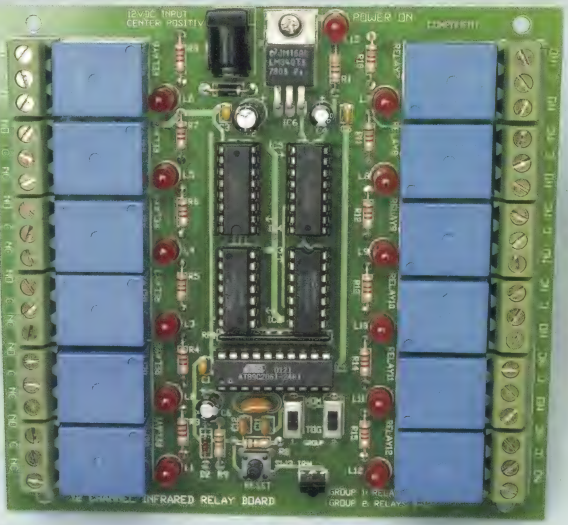


In July we presented a 4-channel UHF remote control system. Here's another remote control – but this one offers 12 channels and operates via infrared from a standard hand-held remote control unit.

The ultimate couch-potato's friend:

A Versatile 12-Channel Infrared Remote Control

Design by Frank Crivelli – Article by Ross Tester

One of the advantages of infrared remote is that there is no radio signal for crooks to monitor and record for use against you later on. Instead, there is a beam of invisible infrared light which comes from a standard hand-held remote control unit.

So from that point of view, it is pretty secure. However, the receiver can be actuated by anyone who has a remote control which uses the same code as yours. So maybe it's not the type of thing you would use to protect the Crown jewels!

There is, though, an enormous variety of tasks to which you could put the unit. Just think of the myriad of things in your home these days which use infrared remote to turn things on and off, change levels, open and close . . . Anything which can be connected to a set of relay contacts, whether normally open nor normally closed, can be converted to remote control.

Perhaps you want to motorise curtains? Turn lights on or off (perhaps some low voltage garden lights)? Add remote control to something that has not already got it? (Oh, come on, there must be something!)

As far as the hand-held remote control itself is concerned, it is a typical commercial unit with 14 pushbuttons. But it does have the advantage of being nondescript – no labelling or branding to identify it nor give any clues as to which of the many infrared codes it uses.

Features:

- 12 channels, each individually controlled
- Infrared operated from commercial hand-held infrared remote
- Long range (>15m) operation
- Relay output – 5A rated changeover contacts
- Two banks of relays (eight and four)
- Each bank can be set to momentary or toggle (push on, push off) modes
- Remote can reset each bank with one button in toggle mode
- One button reset on receiver board
- Receiver is 12V DC operated (30mA standby, 450mA all relays toggled)

How it works

Each button on the hand-held remote control unit transmits a unique code train which modulates a 38kHz carrier, sending a pulse stream from an infrared diode. This method is used in most, if not all, infrared remote controls as it offers a high degree of noise immunity against interfering light sources.

That's about all you need to know about the remote control transmitter. Oh, OK, it's battery operated and it's black!

At the receiver end, an infrared receiver module picks up the modulated infrared signal and extracts the data signal. This is fed into an Atmel 89C2051 microcontroller which has been programmed to decode the signal, determine which one of the 14 it is and set the output pin corresponding to the received code low.

Each output goes to an inverter, one of six in a 74HC04 chip. As you will note from the circuit diagram, Fig.1, there are two such chips and each of their outputs in turn connects to an input in a ULN2003A. This chip contains six relay drivers, actually Darlington pairs (for clarity, only one of the transistors in each Darlington is shown).

In the collector circuit of each of the Darlingtons is an SPDT relay along with a LED and resistor.

When the Darlington turns on, the relay pulls in and the LED lights, giving a visual indication of relay activity. You can hear the relay pull in but with 12 of them on the PC board, it's not easy to work out which one it is!

Each of the relays has a set of changeover (ie, SPDT) contacts. While these contacts are rated at 10A, their associated PC board track widths are not, due to their close spacing. About 5A would be the absolute maximum. (Thickening up the tracks with wire links can increase the current handling capacity).

And for the same (close spacing of tracks) reason, **this PC board is NOT rated to handle 240V AC mains voltages. Steer clear of mains: it bites!**

You might wonder where the usual spike-suppression diodes are across the relay coils. They're actually inside the ULN2003A, so a separate diode is not required.

The relays are organised into two banks, one of eight and one of four, with buttons 1-12 on the remote control operating the corresponding relays (button 1 operates relay 1, etc)

Each of the two banks can be independently set to operate in "momentary" or "toggle" mode via slide switches S1 and S2. In the momentary mode, the relay is energised or closed while ever the keypad button remains pressed. In the toggle mode, one button push closes its relay and a second push of the same button releases it.

And yes, you can have one bank set to momentary and the other set to toggle if you wish.

What of the other two buttons on the remote control – the 13 and 14 buttons?

They are used to release all relays when the circuit is set to the "toggle" mode. Pressing button 13 will release relays 1-8, while pressing button 14 releases relays 9-12.

Pressing the "reset" switch (S3) on the receiver board does the same as pressing both the 13 and 14 buttons on the transmitter – it releases all relays.

The only other sections of the circuit we have not yet mentioned are pretty conventional: a 12MHz ceramic resonator to give the micro-controller its clock pulses, along with a plugpack-powered nominal 12V DC supply (to power the relays and drivers) and a regulated 5V DC supply (to power the rest of the circuit).

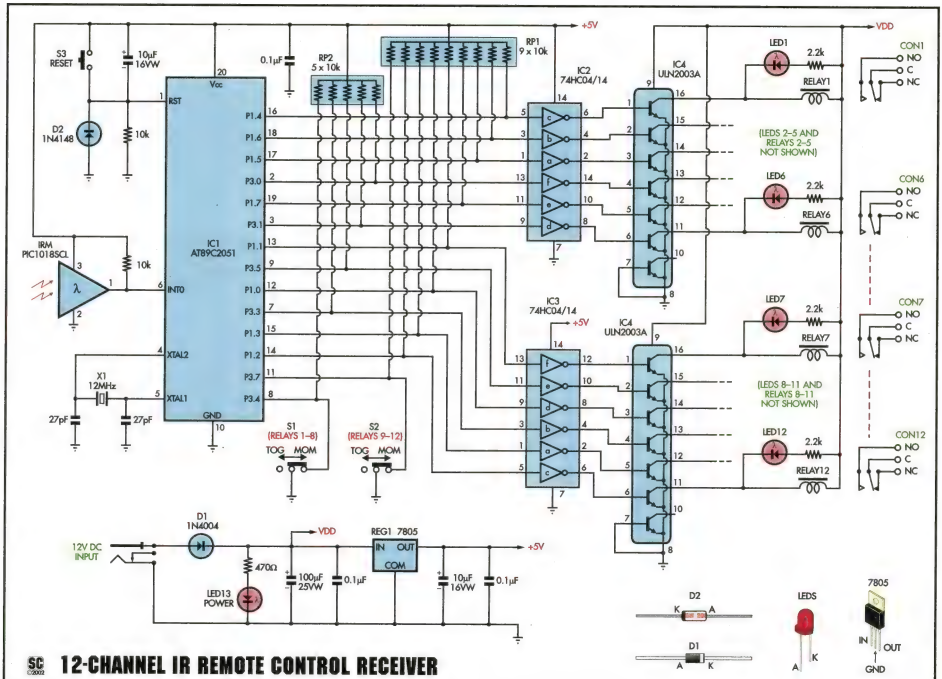
Finally, you might wonder why the inverters are needed. Why not eliminate the inverter (IC2 or IC3) and simply use an active high output from the microcontroller to the relay driver chips? It's all to do with what happens on reset.

On reset (either with the reset switch or via the 10µF/10kΩ resistor power-on reset) the microcontroller's I/O ports are configured as inputs (via internal hardware) and "float" high. If the outputs were connected directly to the relay drivers then the relays would briefly operate during reset.

Of course the relays would be released after reset once the onboard software took over. However, the relays would "flick" on momentarily during reset – and that could be embarrassing!

Using the inverter stage means we

Fig.1 (facing page): the circuit of the receiver section. The transmitter is not shown as it is pre-assembled.



12-CHANNEL IR REMOTE CONTROL RECEIVER

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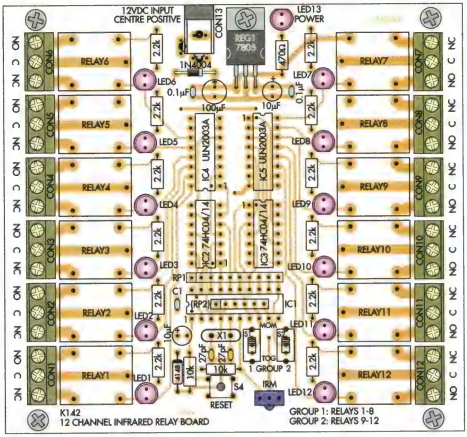
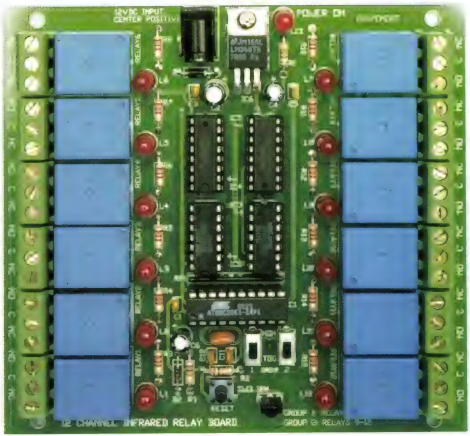


Fig.2: all components mount on a single PC board, shown above same size. It is a double-sided board but only the underside tracks have been shown, for clarity. Shown below is the same-size photograph of the board which should help you in assembly.



can use an active low output to operate the relay and a high to release it - just right during reset! External 10kΩ pullup resistors (all part of resistor arrays RP1 and 2), are used to ensure a 'solid' high level signal to turn a relay off.

Construction

Use the component overlay on the PC board itself, along with Fig.2, to place the components. The following order is a logical way to do it – but do not insert any ICs until after the "Testing" section.

1. Resistors and diodes.
2. IC sockets
3. Resistor networks. Note that RP2 is inserted inside IC1's socket. The small dot at one end of the resistor networks denotes pin 1.
4. Ceramic resonator, capacitors and IR receiver module. The lens bump of the IR module faces outwards.
5. Three switches.
6. DC power jack and 7805 regulator. Use needle nosed pliers to bend the leads of the regulator down 90°. It does not require a heatsink.
7. All LEDs (watch polarity!).
8. Electrolytic capacitors. Make sure you insert them the correct way around.
9. Terminal blocks. Note that the terminal blocks do NOT slide together. Also make sure the wire entry side faces out from the PC board!
10. Relays

Testing

After you have inspected your placement and soldering, connect a 12V DC plugpack. The power LED should light. If it doesn't, check the polarity of your plugpack – it should be standard (centre positive) or the circuit will not work.

Use a multimeter to measure the 5V output from the regulator. The easiest way to do this is across pins 10 and 20 of IC1's socket (pin 20 is positive).

If all is well you can remove the power and insert the ICs. Take care that none of the IC leads are bent under when inserting them into their sockets.

Connect the 12V plugpack again. Put the slide switches in the momentary (MOM) position and press button 1 on the remote control unit. Relay 1 should operate and LED L1 should light. Release the button and the relay should release. Check each of the other

relays in turn by pressing the other buttons. Buttons 13 and 14 have no affect in momentary mode.

Now put the slide switches in the toggle (TOG) position. Press and release button 1 on the remote control unit. Relay 1 should operate (you'll hear it click in) and stay operated. LED L1 should also be on. Press each of the other buttons 2 -12 in turn and note that each relay and its LED is on.

At this point all the relays and LEDs should be on. Now press button 13. All Group 1 relays (1-8) should release and LEDs 1-8 should go off. Pressing button 14 should release all Group 2 (9-12) relays and turn off their associated LEDs, 9-12.

Repeat the process except for pressing buttons 13 and 14. Instead, press the "reset" button on the receiver and again, all LEDs should go out and relays release.

And that's just about all there is to it. All you have to do now is work out how to link it into whatever you are going to control. Remember, you have a normally open and a normally closed contact on each relay (normally open means open circuit when the associated LED is off).

Aw, shucks – it doesn't work!

First thing to check is that you have batteries in your remote control. Yes, it sounds stupid . . . until you check and they aren't there (none are supplied in the kit because they could be dead or leaking by the time you get them!)

Next, check your component placement (and polarity) on the receiver board once again.

And while you're at it, check all soldered joints carefully under a good light. Dry joints are the most common reason for circuits not working. Resolder any that look suspicious.

Are the electrolytic capacitors and diodes the right way around? Are the ICs the right way around? Are any IC leads bent up under the IC body (ie, not in the sockets)? Check again that the regulator is still producing 5V.

If it still doesn't work, turn it off and carefully remove the microcontroller IC from its socket, then reconnect power. In turn, short pins 1, 3, 5, 9, 11 and 13 of each of the inverter ICs (IC2, IC3) to ground. That should cause the relays to pull in and the LEDs to light.

If it does, the problem lies earlier on – either in the microcontroller or before it. Check that the infrared receiver module is properly soldered in.

A properly functioning infrared receiver module will have around 5V between output and ground at rest, dropping to about 4.5V when it is receiving a signal from the hand-held transmitter.

If you get this result, the problem almost certainly lies in the microcontroller – more than likely one of its pins not seated properly in the socket.

Where from, how much?

The circuit is copyright © Kits-R-Us. Kits can be purchased from Oztronics via their website (**www.oztronics.com**). The complete kit, including the pre-assembled hand-held remote control unit, is $128.70 including GST, postage and handling.

A four-channel "short form" kit (ie, with four relays but otherwise identical) is available from Oatley Electronics (**www.oatleyelectronics.com**) for $79.00 plus P&P. They have 4-relay expansion kits for $16.00 each and, if you need additional remote controls, they are available for $8.00 each. **SC**

Parts List – 12-Channel Infrared Remote Control

1	PC board, 122 x 113mm, coded K142	
1	remote control unit (batteries NOT supplied)	
1	ceramic resonator,12MHz	(X1)
12	relays, 12V coil, SPDT contacts	(RELAY1-12)
4	3-way terminal blocks, PC mounting	
1	DC power jack, 2.5mm	
2	slide switches, SPDT	(S1,2)
1	pushbutton switch	(S3)
2	IC sockets, 14 pin	(for IC2,3)
2	IC sockets, 16 pin	(for IC4,5)
1	IC socket, 20 pin	(for IC1)
1	3mm screw, 6mm long	(for REG1)
1	3mm nut	(for REG1)

Semiconductors

1	AT89C2051 pre-programmed microcontroller	(IC1)
2	74HC04 or 74HC14 hex inverters	(IC2,3)
2	ULN2003A relay drivers	(IC4,5)
1	7805 voltage regulator	(REG1)
1	IR receiver module 'Waitrony' PIC1018SCL	(IRM)
13	5mm red LEDs	(LED1-13)
1	1N4004 diode	(D1)
1	1N4148 diode	(D2)

Capacitors

1	100µF 25V electrolytic
2	10µF 16V electrolytic
3	100nF (0.1µF) monobloc (code 104 or 100n)
2	27pF ceramic (code 27 or 27p)

Resistors (0.25W, 5%, carbon film)

1	470Ω	
12	2.2kΩ	
2	10kΩ	
1	10kΩ resistor array 10 pin 9 resistor 'A' type	(RP1)
1	10kΩ resistor array 6 pin 5 resistor 'A' type	(RP2)

More info?

For any technical problems or questions, contact the kit developer at **frank@oztronics.com.**

If you would like more info on the Waitrony Infrared Receiver Module it can be downloaded from **http://kitsrus.com/pdf/pic1018scl.pdf.**

Data on the AT89C2051 microcontroller can be found on the Atmel website at **www.atmel.com.**

Information on other kits in the Kits-R-Us range is available from the web page at **http://kitsrus.com**.

By PETER SMITH

50-Watt DC Electronic Load

This simple project is ideal for testing DC power supplies, shunt regulators & constant current sources. It's also a great way to check battery capacity and can even be used as a current limiter for an existing DC supply.

IF YOU'RE INVOLVED with servicing or building power supplies, you'll wonder how you ever managed without this ultra-useful test-bench tool! This electronic load enables you to observe DC power circuits under a variety of load conditions, all of which can be quickly "dialled-in" using a single potentiometer.

An electronic load is good for testing batteries too. But why use an electronic load instead of a resistive load? Let's find out.

Resistance is futile

Electronic loads are often called "dummy" loads. This name refers to the fact that they replace or simulate a real load. For example, a dummy load might be used at the output terminals of a DC power supply to allow measurement of ripple voltage at different current levels. The dummy load enables us to conveniently program any load resistance (and thus current flow) that we desire.

Of course, a dummy load need not be electronic – it could consist of a rheostat or even a bunch of high-power resistors in series and/or parallel. However, these methods tend to be rather inflexible and lack adjustment range and resolution.

Rather than providing a variable load resistance, the electronic version presented here provides variable cur-

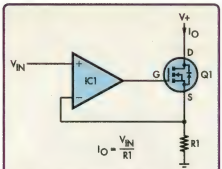


Fig.1: the basic scheme for a current sink. The current through R1 depends on the voltage applied to IC1's non-inverting input and is independent of the supply voltage.

rent sinking. This means that regardless of the applied voltage, the current that it "swallows" remains exactly as set. The required load current is simply "dialled in" via a multi-turn potentiometer, up to a maximum of 10A.

Note that, to handle both low and high-power circuits, we've included 1A and 10A switch-selectable current ranges.

Current limiting

Earlier on, we stated that the Electronic Load could be used to provide current limiting for an existing power supply. How do we do that? Simple – just connect the load terminals in series with the negative supply lead.

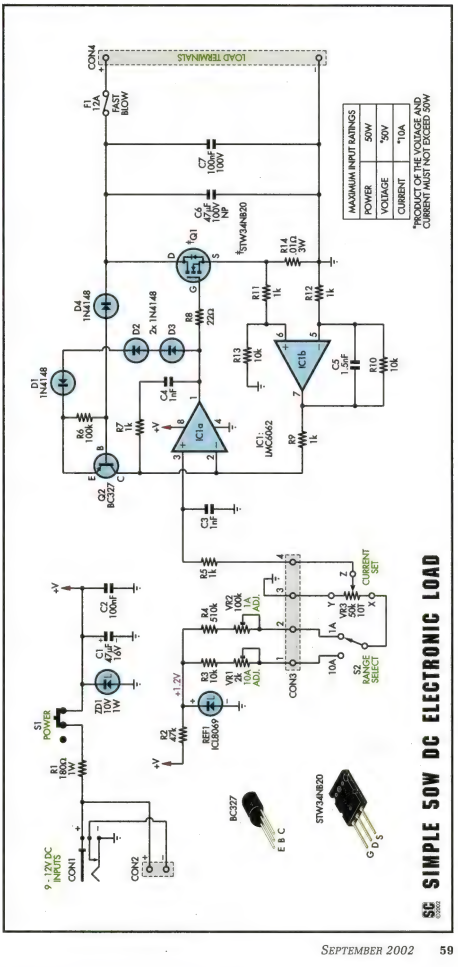
It's then just a matter of winding up the pot to set the required current limit.

How it works

The Simple 50W Electronic Load is based around an adjustable precision current sink. Fig.1 shows the elements of a basic current sink. It consists of op amp IC1, power MOSFET Q1 and resistor R1 and operates as follows:

Initially, both the inverting and non-inverting inputs of IC1 are at 0V, so the output is also at 0V. When a voltage (V_{IN}) is applied to the non-invert-

Fig.2 (right): the final circuit for the Electronic Load. IC1b amplifies the voltage across feedback resistor R14 by a factor of 10 and this allows R14 to be substantially reduced in value (which, in turn, reduces its power dissipation). Q2 and diodes D1-D3 clamp the output of IC1a when the load voltage is very low, to protect Q1.



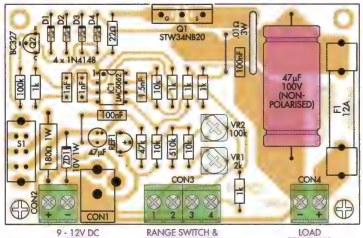


Fig.3: install the parts on the PC board as shown in this wiring diagram. The .01Ω resistor looks like a thin metal U-shaped band and is mounted by pushing it down until its shoulders contact the board (see photo).

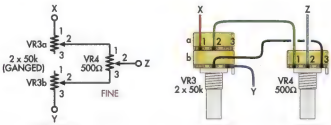


Fig.4: if you can't get a multi-turn pot (or just want to save money), here's how to wire up two low-cost pots as coarse and fine controls instead.

ing input, the op amp's output begins to rise rapidly towards the positive supply rail. When this voltage exceeds the MOSFETs gate threshold voltage, it begins to conduct, causing current (I_O) to flow.

Obviously, the current flow through resistor R1 causes a voltage drop across it:

$$V = I_O \times R1$$

This, in turn, is fed back to the inverting input of IC1. The op amp's output voltage will continue to rise until this feedback voltage equals the voltage on the non-inverting input (V_{IN}). Therefore, we can say that:

$$I_O = V_{IN}/R1$$

As you can see, the current flow (I_O) in the circuit is independent of the applied voltage (V+). Instead, it depends on the voltage applied to the op amp's non-inverting input (V_{IN}).

Our final design (see Fig.2) expands on the above by adding an additional op amp stage (IC1b) in the feedback loop. This stage amplifies the voltage across the feedback resistor (R14) by a factor of 10, as set by resistors R10 and R12. And that, in turn, allows us to reduce the value of R14 and thus reduce its power dissipation to sensible levels.

The basic current sink described above has one major drawback when used in high-current applications, however. Consider the case where a certain current is "dialled-in" but little or no voltage is present across the load terminals. In this case, insufficient current flows in the circuit to generate enough voltage across R14 to satisfy the feedback loop.

This means that IC1a's output will be at the supply rail voltage, turning Q2 fully on. If a low-impedance source is now connected to the load terminals, a massive instantaneous current will flow, limited only by the drain to source "on" resistance of Q4 and the .01Ω feedback resistor. Result – exit one MOSFET!

To prevent this, we've included a clamping arrangement for the op amp, formed by diodes D1-D4, transistor Q1 and resistor R6. This circuit works as follows: when the load voltage is below a certain threshold, Q2 turns on (via D4) and so pin 1 of IC1a is effectively clamped to four diode drops above pin 2 – ie, approximately 2.9V.

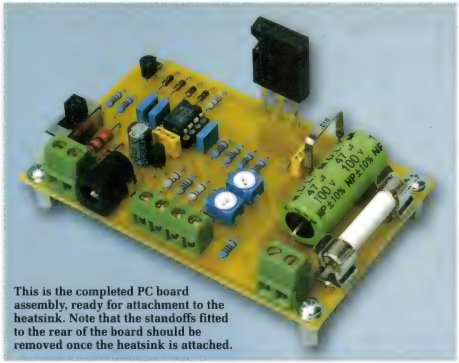
As a result, IC1a's output is effectively below the MOSFET's gate threshold voltage and so the current flow through this device is kept to a very low level. Conversely, when the load voltage rises above the threshold, Q2 turns off and plays no further role in the circuit – ie, feedback control is now via IC1b.

Table 2: Capacitor Codes

Value	Alt. Value	IEC Code	EIA Code
100nF	0.1uF	100n	104
1.5nF	.0015uF	1n5	152
1nF	.001uF	1n	102

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	510kΩ	green brown yellow brown	green brown black orange brown
❑	1	180Ω 5%	brown grey brown gold	not applicable
❑	1	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	3	10kΩ	brown black orange brown	brown black black red brown
❑	3	1kΩ	brown black red brown	brown black black brown brown
❑	1	22Ω	red red black brown	red red black gold brown



This is the completed PC board assembly, ready for attachment to the heatsink. Note that the standoffs fitted to the rear of the board should be removed once the heatsink is attached.

This arrangement provides a much smoother current ramp, with less overshoot when cycling the input.

The load current is controlled by external potentiometer VR3, which varies the voltage applied to the non-inverting input of IC1a. With range switch S2 in the 1A position, the maximum output from VR3 is 100mV. Alternatively, when S2 selects the 10A position, the maximum output is about 1V.

To ensure that the set current remains stable with temperature and input voltage variations, a precision voltage reference IC (REF1) is used to provide a steady 1.2V to the divider networks. Trimpots VR1 and VR2 allow for full-scale adjustment of each range, if required.

Unlike many electronic load circuits, this unit sources its supply voltage independently of the load terminals. This ensures that the circuit continues to operate, even when the voltage at the load terminals drops to just a few volts. As the circuit draws only about 390µA, it can be powered from a 9V PP3 battery.

Alternatively, a 2.5mm DC socket is provided for 9-12V DC plugpack operation.

Construction

All parts except the potentiometer (VR3) and range switch (S2) mount on a 58 x 93.5mm single-sided PC board. Fig.3 shows how the parts are installed.

Begin by installing the two wire links and follow with all the 0.25W resistors. Diodes D1-D4 and zener diode ZD1 can go in next but watch their orientation – the cathode (banded) ends must be aligned as shown.

Once the diodes are in, install all remaining components in order of their height. Transistor Q2 and power resistor R14 should be left until last. Before soldering R14, make sure that its shoulders are seated firmly against the PC board surface.

The mounting position for Q2 will depend on the chosen heatsink. On our prototype, we inserted it into the PC board just far enough for proper soldering. With 10mm spacers fitted to the board, this placed Q2 near the centre line of the heatsink for best heat dissipation.

External hardware

The current set potentiometer (VR3) and range switch (S2) are connected to the PC board via terminal block CON3. You can use light-duty hookup wire for this job. The circuit diagram (Fig.2) shows the pinouts for CON3.

If you don't need the fine resolution of the 1A range, then you can save wiring (and money) and connect VR3 directly to the 10A circuit, eliminating the need for the range switch.

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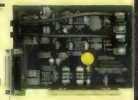

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Parts List

1 PC board, code 04109021, 58 x 93.5mm
1 SPDT PC-mount sub-miniature slide switch (S1) (Altronics S-2060, Jaycar SS-0823)
1 SPDT miniature panel-mount toggle switch (S2)
1 heatsink to suit (0.6°C/W thermal resistance or lower)
4 2 way 5mm pitch terminal blocks (CON2 - CON4)
3 M3 x 6mm cheese head screws
2 M3 x 10mm tapped spacers
1 M3 flat washer
2 PC-mount 3AG fuse clips
1 12A 3AG fast-blow fuse

Semiconductors
1 LMC6062IN dual CMOS op amp (IC1) (Farnell 270-854)
1 STW34NB20 N-channel MOSFET (Q1) (Farnell 498-180)
1 BC327 PNP transistor (Q2)
1 ICL8069 1.23V voltage reference (REF1) (Farnell 410-895)
4 1N4148 diodes (D1-D4)
1 1N4740A 10V, 1W zener diode (ZD1)

Capacitors
1 47µF or 56µF 100V non-polarised axial-lead electrolytic (Altronics R-6415, Jaycar RY-6916)
1 47µF 16V PC electrolytic
2 100nF 100V MKT polyester
1 1.5nF 63V MKT polyester
2 1nF 63V MKT polyester

Resistors (0.25W, 1%)

1 510kΩ	3 10kΩ
1 180Ω 1W 5%	3 1kΩ
1 100kΩ	1 22Ω
1 47kΩ	

1 0.01Ω 3W 1% power (Welwyn 'OAR' series) (Farnell 327-4718)

Potentiometers
1 2kΩ miniature horizontal trimpot (VR1)
1 100kΩ miniature horizontal trimpot (VR2)
1 50kΩ multi-turn linear potentiometer (VR3) (Farnell 351-817) -or-
1 50kΩ dual-gang linear potentiometer (VR3) (coarse adjustment) -and-
1 500Ω linear potentiometer (VR4) (fine adjustment)

Miscellaneous
Heatsink compound, 50mm-length (approx.) tinned copper wire for links, light duty hook-up wire

Note that the wire length should be kept as short as possible to reduce potential noise pick-up.

It may help to tightly twist the wires to VR3 or, even better, use a length of shielded cable. The cable shield should be connected to ground (CON3, pin 3) at one end and to terminal "Y" and the metal shell of the potentiometer at the other end.

For most applications, a 10-turn wire-wound potentiometer is preferred for VR3. However, these can be expensive and difficult to obtain. An alternative arrangement using standard carbon track potentiometers is shown in Fig.4. Here we've shown how a 50kΩ dual-gang pot (VR3a & VR3b) and a 500Ω pot (VR4) can be wired together to give both coarse and fine adjustments.

Keeping your cool

Apart from aesthetic reasons, there is no real need to house your completed work. For long service life, it can simply be mounted on a thick aluminium baseplate.

However, if you prefer to build it into a case, then allow for plenty of ventilation. If the heatsink fins are vertically arranged, then you should install small spacers under the heatsink to allow airflow up through the fins. Ventilation holes positioned directly above and below the fins will make the most of the "chimney" effect.

Alternatively, if the fins are horizontally arranged, then you'll almost certainly require forced air cooling of some kind.

A single 3mm hole is required for attaching the power MOSFET. Try to position this as close to the centre of the heatsink as possible and be sure to remove any sharp edges that result from drilling. You can deburr the hole using an oversize drill.

Mounting the MOSFET

50W continuous power dissipation is quite a bit to ask from a single plastic power MOSFET, even in the larger TO-247 package. Therefore, we have to make sure that as much of the heat as possible flows out of the package and into the heatsink. In other words, proper mounting of the power MOSFET (Q1) is vitally important!

Unlike many other projects described in SILICON CHIP, the MOSFET should not be electrically isolated from the heatsink. To mount it, first apply a thin, even smear of heatsink compound to the entire rear face of Q1 as well as the area that it will contact on the heatsink. That done, attach Q1 to the heatsink using an M3 screw with a flat washer and tighten it up firmly.

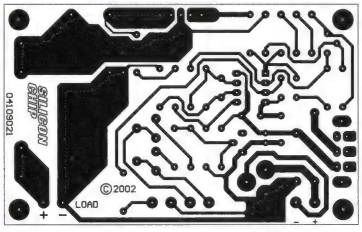

Fig.5: this is the full-size etching pattern for the PC board.

Note: direct connection between the transistor and heatsink means lower thermal resistance but it does have a downside. Along with the centre pin, the metal contact area of the transistor is connected to the drain, so the heatsink is always at positive load terminal potential.

That means that you have to make sure that the heatsink doesn't short against anything when using the Electronic Load.

Prototype performance

We checked the full-power performance of our prototype with an infrared thermometer and an ambient temperature of 22°C. The heatsink temperature rose to 70°C, with Q1 running about 10°C hotter.

Although the transistor temperature was within specification, we hadn't expected the thermal resistance between it and the heatsink to be so high. A little investigation revealed that the heatsink surface was not completely flat, resulting in only partial contact with the transistor!

Watch this point when buying a heatsink – make sure that the contact area is completely flat.

Circuit protection

The 12A fast-blow fuse included in the circuit provides only basic overcurrent protection. No over-voltage or overload protection has been included, which is why we've dubbed it the "Simple" Electronic Load.

Having said that, the MOSFET we've selected for this circuit is a very robust device, so you'd have to exceed the ratings listed in Fig.2 by a fair margin in order to destroy it.

If you're interested in increasing the robustness even further, then one option might be to use a special "protected" MOSFET in place of the standard part specified for Q1. Manufacturer STMicrolelectronics produce a range of such devices, called OMNIFETs. Additional circuits built into these devices add thermal, short-circuit and over-voltage protection to normal MOSFET function.

A suitable device from the range is the VNW100N04 (rated at 42V). This is available locally from Farnell Electronic Components.

Note that the OMNIFET's over-voltage protection is intended for transient protection only. This means that you should not apply a higher than specified maximum drain to source voltage across the load terminals.

Check out the STMicrolelectronics web site at http://us.st.com for more details on these devices.

Calibration

Trimpots VR1 and VR2 provide full-scale trim for their respective ranges. To adjust them, insert a 10A or higher rated ammeter in series with the positive load terminal and connect a suitable power source. Set S2 to the 1A range and apply power. Wind VR3 fully clockwise and adjust VR2 for a reading of 1.00A on your meter.

Now toggle S2 to the 10A position and repeat the procedure, this time adjusting VR1. Be sure not to exceed the maximum power rating, which means that the input voltage must not be above 5V when the load is swallowing 10A.

The position of VR4 should now correlate roughly with the desired percentage of full-scale current. For example, on the 10A range with VR4 at centre position, current draw should be about 5A. Of course, for real accuracy you'll need to leave your ammeter connected.

Load modulation

As presented, this project is intended as a DC current sink. However, the frequency response of the circuit is such that it should be possible to modulate the control voltage to IC1a by various external means should you have such a requirement.

No promises though – we haven't tried it! If you want to give it a go, we suggest a maximum modulation frequency of about 1kHz. **SC**

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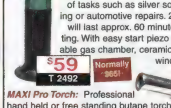

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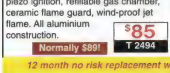

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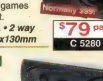

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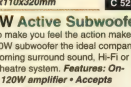

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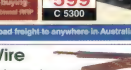

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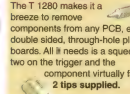

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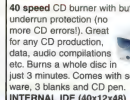

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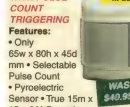
AUSSIE MADE thousands in use!

Features:

- Only 65w x 80h x 45d mm • Selectable Pulse Count • Pyroelectric Sensor • True 15m x 15m 90° Detection Pattern • Surface or corner mount • 9-15V DC • Suits most alarm panels • N.C. Alarm contacts in standby condition • N.C. Tamper switch • Adjustable Beam Height Angle • User selectable walk test LED, single pulse or triple count modes & range control.



WAS $40.95!
$29 S 5305

PIR Detector

WITH DUAL OUTPUTS

SAVE OVER 35%!

The dual relay output is ideal for triggering a VCR as well as the alarm system when an intruder is detected.

Features: Excellent RFI Immunity • White light Immunity • Insect-proof housing • Temperature compensation • Self-testing software • Tamper protection • **Dual relay output** • Includes unique corner mount mounting bracket • Adjustable coverage area

State-of-the-art Digital Signal Analysis virtually eliminates false triggering!

$40 S 5307

Glass Breakage Detector

Features: Acoustic pickup of breaking glass • Useable up to 9m away • Variable sensitivity • Powered by 10 -16V DC • NC contacts • Tamper switch • Alarm output indicators

$39 S 5365 SAVE $13.45!

360° [illegible] Detector

WITH SELECTABLE Pulse Count TRIGGERING

Fantastic for open areas such as living rooms, foyers and offices. Covers a large area with a single detector. Employing a low noise dual element pyro-electric sensor and features pulse count detection circuitry to avoid false triggering. ***Features***: 360° conical pattern • 8-16V DC • Selectable Pulse Count • NC contacts • NC Tamper switch. **Was $49.**

$35 S 5311

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KITS, KITS, KITS!

Minimitter

(SC April '01) Mini FM transmitter capable of driving a dipole antenna.
Was $39.95

$34 K 1125

Mini Strobe Kit

(EA August 97) Great little kit with both practical and fun uses. Set the timing on your car, or spin out your friends with a light show!
Was $21.50

$15 K 5785

HURRY ONLY ...14 LEFT!

PIC Auto Ammeter Kit

(SC June 2002) An ammeter kit is essential for monitoring your cars electrical system and battery. A programmed PIC chip allows for much easier kit production and simplified circuit.

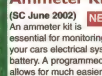
NEW!

$74.95 K 4336

Remote Volume Controller Kit

(SC June 2002) This remote control volume kit can be built into just about any audio project. New PIC based model can be controlled by most commonly available learning remotes.

NEW!

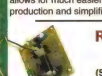


$49.95 K 5026

Headphone Volume Controller Kit

(SC May 2002) A great effective line level amplifier kit for headphones. Crank up the volume on your PC sound card or listen to DVD/CD's at the sound level you prefer.

NEW!



$19.95 K 5506

The Battery Guardian Kit

(SC May 2002) Stop your car fridge from running your battery flat. *Features:* 10A rating • Low power consumption • Cutout alarm • LED indication of cutout • Automatically re-connects battery power

NEW!

$47.95 K 4080

HIGH PERFORMANCE 6" x 9" SPEAKERS

These high quality, extremely responsive speakers are ideal for the beginnings of a quality car sound system. Optimised for infinite baffle for use as parcel shelf speakers.

Features: 250W max power, 88W RMS • 4 way system • 4 ohms impedance • Infinite baffle optimised bass driver • 60Hz - 18KHz Freq. response

$69 C 9365 SAVE $30!

4 Channel 600W Car Amp

With up to 600W of power , "D" Class MOSFET technologies and configurable in four, three or two channels the C 9250 is ideal to form the core of a thunderous car audio system.

$249 C 9250 SAVE $40!

Features: 4/3/2 Channel operation • Stable into 2 ohms • Separate gain controls for each audio channel • 6dB or 12dB bass boost • Gold plated contacts • Stylish low profile chassis • Low THD • Adjustable front and rear low pass/ high pass filters • Low power speaker or line level inputs • Bridgeable terminals

Retro Style : New age sound

TDK have done it again with a new release in their tremor series of desktop speaker systems. This time its a classy looking 40W 3 piece. Ideal for computer systems, fully magnetically shielded.
LOOK AND SOUND SENSATIONAL

ALL NEW!

$79.95 D 0776

40V 1A Power Supply Kit

(SC July, '2000) Suitable for use as a bench top/ Laboratory power supply. Output voltage is continuously variable from 1.23 to 40V, at up to 1A. Supplied with a rugged steel case, it features a precision LCD display for voltage & current. It even features variable current limiting.

Was $149.95!

$119 K 3250

19 Range DMM

19 range DMM with built in HFE transistor and diode test functions. Ideal for the cash strapped student or enthusiast. Packed with features and great value for money! Pick one up for the toolbox!
Was $15.95

$13.95 Q 1053

BENCHTOP SUPPLY!

This power supply is ideal for service work, project design & testing a wide range of electronic appliances.

Features: Delivers up to 3A current • Separate controls for voltage and current limiting • Fixed 12V & 5V output rails • Fully adjustable from 0- 30V • Precision LCD voltage & current meters • Fully regulated • Short circuit and overload protection

NORMALLY $269! Not a misprint!, but this offer is limited to the first 25 callers only!

$199 M 8200A

Auto Ranging DMM

Autoranging multimeters are great if you don't have a free hand to change ranges on your DMM. Ideal for service persons or hobbyists. **Was $65!**

Features • Manual override of auto-ranging • Range hold & data hold • Auto power off •°C Temperature range • AC - < 400mV to 600V • DC Volts < 400mV to 600V • Resistance - < 400Ω - 40MΩ • Continuity buzzer • AC/DC current < 400µA - 10A • Transistor tester • Diode check • Rubber holster included • 3 year warranty

$58 Q 1132

Includes K-Type Temp Probe.

Digital Hygrometer & Thermometer with Clock

Ideal for fish tanks, home brew kits, cellars!

Features: • Large LCD • 12/24 hour clock • Internal/External temperature sensor • Humidity • Backlighting • 4 mode temperature alert (audible alarm), within range, out of range, high and low temperature • -50°C to +70°C • Max/Min memory • Sensor waterproof to 3m

$40 A 0156

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BUNBURY	Leading Edge Hi-Fi	(08) 97216222	BOWEN HILLS	Prime Electronic Comp.	(07) 32527466	ENFIELD	Aztronics	(08) 83496340
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VIC			SOUTHPORT	Prime Electronic Comp.	(07) 55312599	WOODVILLE STH.	Force Electronics	(08) 83471188
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It's now very easy to build short range two-way wireless data communication functions into a wide variety of equipment, using the Nordic family of UHF transceivers-on-a-chip. As well as the chips themselves, the company makes a range of pre-built evaluation kits for designers.

Review by
JIM ROWE

One-chip Transceivers for easy UHF Data Communications

Although digital mobile phones have grown in spectacular fashion over the last few years, the growth in wireless data communication has also been impressive.

No doubt for the same reason, too: once you remove the need for a connecting cable, there's greater convenience as well as many more potential applications.

But the benefits of wireless data are by no means confined to high speed, wide bandwidth spread-spectrum technologies like Bluetooth and IEEE 802.11.

A lot of short range applications can be served just as well by lower speed, lower bandwidth technology such as FSK (frequency shift keying, or 'digital FM').

This can provide a very cost-effective solution for applications like alarm and security monitoring, home automation, remote control, short-range telemetry, automatic meter reading, toys and so on.

Putting this technology to work has been made particularly easy by Nordic VLSI ASA, a chip design and manufacturing company established in Norway in 1983.

In the last three years, Nordic has released a range of complete single-chip FSK data transceivers and transmitters, which are designed to operate on frequencies in the UHF bands allocated in most countries for either ISM (industrial, scientific and medical) or LIPD (low interference potential device) use.

Using these chips, a designer can provide their product with fully transparent short range two-way low speed data communications very easily.

All that's needed, apart from each chip itself, is a single crystal, a few SMD components and an antenna – which can be either an off-board quarter-wave whip or an on-board rectangular loop etched directly on the PC board.

Even with the latter approach, the total board real estate required can be as little as 880 square millimetres (40 x 22mm).

A good example of the Nordic chip range is the nRF401, a complete FSK data transceiver which can operate on either of two channels in the 433.05 - 434.79MHz ISM/LIPD band.

Housed in a very compact (7 x 5 x 2mm) 20-pin SSOIC package, the nRF401 chip can handle data rates up to 20kb/s (kilobits per second). Its transmitter can achieve up to +10dBm/10mW of RF output (continuously adjustable down to -8.5dBm) with a deviation of ±15kHz, while the receiver has a sensitivity of -105dBm for a BER (bit error rate) of less than .001 at 20kb/s.

The chip operates from a single DC supply rail of +3-5V, and the current drain in receive mode is typically only 11mA.

The drain in transmit mode varies between 8mA and 26mA, depending on the RF output power level (which is set very simply via a single external resistor).

The nRF401 also offers a 'standby' operating mode, where its current drain drops to a mere 8μA when the PWR_UP pin is taken to logic low level.

It can become fully operational in either transmit or receive mode only 3ms after the PWR_UP pin is raised to logic high level, while switching between receive and transmit modes involves a setup delay of either 1ms (Rx to Tx) or 3ms (Tx to Rx), after the TXEN pin is taken high or low respectively.

Thanks to its internal digital divider and PLL (phase-locked loop), the nRF401 needs a clock frequency of only 4.00MHz, which can be generated by the chip itself using a crystal and three other SMD components.

Alternatively, it can accept a 4.00MHz clock signal from a microcontroller or similar, if this is already available. Either way, it can generate from the 4.00MHz clock all frequencies needed for FSK transmission and reception on either 433.92MHz or 434.33MHz, selected by taking the chip's CS pin to either logic low or high levels.

As you can see from Fig.1, the only other external components needed are two chip capacitors and a resistor for the PLL loop filter, a chip inductor for the VCO, a chip resistor from the RF-PWR pin to ground to set the RF output level, and some components to couple the chip's push-pull RF outputs to whichever antenna is used.

With an off-board whip antenna, the latter involves four chip capacitors and a pair of chip inductors, while an on-board loop antenna involves three chip capacitors and a resistor.

The nRF401 needs no special setup or configuration and handles a standard serial bitstream so there's no need for precoding of data. In fact it's designed to act as an essentially 'transparent' physical-layer data interface, in either direction.

UHF data communications couldn't be much simpler!

Evaluation kits easy

To make it easy for designers to build the nRF401 into their products, Nordic provides two different evaluation kits based on the chip. Each in-

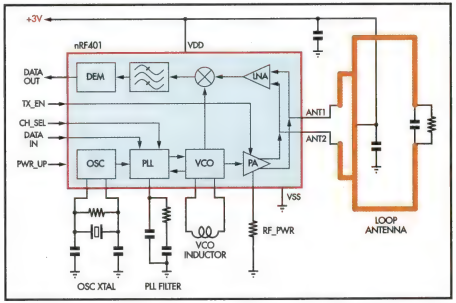
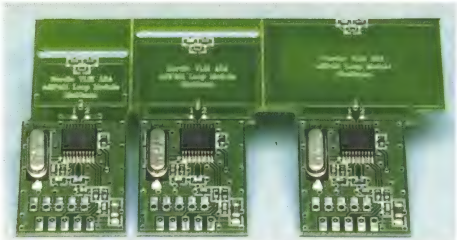


Fig.1: this is the circuit of the loop antenna version of the nRF401 evaluation kit. Three sizes of board are included, letting you determine optimum power output and current drain for a particular application.



In the LOOPKIT, you don't get just one pair of modules, but THREE pairs – each with different loop sizes (18 x 10mm, 25 x 15mm and 35 x 20mm). This allows quick checking of the loop size needed for a particular application.

cludes fully assembled PC board transceiver modules ready for operation, plus all necessary chip data and kit applications info.

One is the nRF401-EVKIT, which provides two transceiver modules complete with matching 'rubber ducky' quarter-wave whip antennas.

The other kit is the nRF401-LOOPKIT, which as the name suggests, provides modules featuring on-board loop antennas.

However with this kit you don't get just one pair of modules, but THREE pairs – each with different loop sizes, to allow quick checking of the loop size needed for a particular application. The three loop sizes provided are 18 x 10mm, 25 x 15mm and 35 x 20mm.

Using one or the other of these evaluation kits, it should be very straightforward to check out the feasibility of providing your equipment with short range two-way data comms, and also to finalise the RF power levels and antenna size required.

Other devices too

The nRF401 isn't the only data comms chip in the Nordic range. There's also the nRF403, which is very similar to the 401 except for the frequencies of its two UHF channels.

One is still in the 433MHz LIPD band but centred on 433.93MHz, while the second channel is centred on 315.16MHz.

This frequency is also in an Australian LIPD band (304.05-328.65MHz), but one allocated for use by personal safety alarms, car alarms and remote door locking systems and home detention devices, with a maximum power level of either 10μW or 200μW rather than the 25mW limit applying to the 433MHz band.

So if the nRF403 is used on this channel, its output power will need to be throttled well back.

There's an evaluation kit for this chip too, known as the nRF403-EVKIT. This contains two transceiver modules with matching 315MHz helical antennas, plus all data and documentation.

Another transceiver in the range is the nRF903, which comes in a 32-pin TQFP package and offers more functionality than either the 401 or 403. The maximum power output of the 903 is still 10mW (+10dBm) but the chip can now operate on three different UHF bands: the 433MHz band, the 868-870MHz band and the 902-928MHz band.

Thanks to an inbuilt synthesiser, it can also operate on a choice of 256 channel frequencies in each of these bands.

This means that the 903 can be easily programmed for operation on virtually any frequency in the Australian 433.05-434.79MHz and 915-928MHz LIPD bands, but its 869MHz option probably can't be used here because this band is not allocated for ISM or LIPD operation.

The nRF903 is configured with its band and channel frequency information by means of a 14-bit control word, clocked into the chip via a serial peripheral interface (SPI).

Two bits of the same control word are also used to set RF output power level in 6dBm steps from -8dBm to +10dBm, while another two bits are used to set the frequency of the 903's clock output for driving an external microcontroller.

Other features of the nRF903 transceiver include a higher maximum data rate of 76.8kb/s, plus GFSK (Gaussian frequency shift keying) modulation and demodulation capability. There's an evaluation kit for the nRF903 too, complete with quite a lot of applications info.

These appear to be the only full UHF data transceiver chips in the Nordic range, although a chip for the 2.4GHz LIPD band is apparently in the works and due for release soon.

Transmitter range

At present the other chips available are transmitters, rather than transceivers.

These include:

- the nRF402, which operates on the 433MHz band and is fully compatible with the 401 and 403 transceivers;
- the nRF902, which comes in an 8-pin SOIC package and operates on any frequency in the range 862-870MHz, with a maximum output of +10dBm and data rates up to 50kb/s;
- and the nRF904, also in an 8-pin SOIC package, which operates on any frequency in the range 902-928MHz, with a maximum output power of +1dBm (1.25mW) and a maximum data rate of 50kb/s.

Local availability

So if you need to provide some of your products with short range data communications capabilities, the Nordic range of single-chip UHF transceivers and transmitters is well worth checking out.

They work on a number of our allocated LIPD bands, they're easy to use and Nordic provides designers with a high level of support in the way of evaluation kits and applications information.

They're readily available in Australia from IRH Components, a division of Delta Electrical Group. You can contact them on 1800 252 731 (02 area call 9364 1766); or by email at sal10@irh.com.au

More information is available at both the IRH (www.irh.com.au) and Nordic (www.nvlsi.no) websites. **SC**

PRODUCT SHOWCASE

Redback "Solutions" audio installation tools

Redback **Solutions** is a range of audio tools designed to help overcome common problems during installation of audio systems.

The half-width 1RU design allows for individual units to be used stand alone, or with the use of the custom bracket up to 2 units can be rack mounted side by side. All models are designed and manufactured in Australia.

The mix of products has been selected after repeated requests from leading sound contracting companies. There are plans to include several new models in the **Solutions** range in the near future and Altronics Managing Director, Brian Sorensen, will be happy to hear suggestions from contractors and other audio users for the types of products they would like to see added to the range.

Currently available are the following models:

A 5104 – Audio Distribution Amp 1 in – 4 out; A 5120 – A/V Distribution Amp 1 in – 4 out (pictured top); A 4804 – Balanced Line Pre Amp 1 mic / 1 Aux – 1 output (pictured below); A 5115 – Phantom Power Supply 2 channel; A 5110 – Di box with inbuilt EQ; A 8300 – 24V DC 1 Amp Power Supply.

Units can be powered from either dedicated plug packs or when multiple units are used in one system, several units can be powered from the M 8300 Power supply.

The **Solutions** range are priced $199.00 each including GST.

Contact:
Altronics Distributors
174 Roe St Northbridge WA 6003
Ph: (08) 9428 2199 Fax (02) 9428 2198
Website: www.altronics.com.au

Prototype RF screening system

When electronic engineers and designers are developing new applications, achieving radiated emissions compliance is a key consideration. Where RF screening is required, costly one-off screens of various shapes and sizes often need to be made.

Microponents, (Birminghman, UK) has a very flexible RF Screening System to provide an "instant fix".

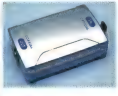
The system is very flexible, allowing engineers to build screening enclosures of various sizes, shapes and heights. A profile can be formed while maintaining 0.1-inch spacing, even around corners, to fit on development boards. It can be assembled without tools into various shapes, is solderable and has a long shelf life.

The kit can currently be purchased directly from Microponents, however, distribution rights will be announced towards the end of 2002.

Contact:
Microponents Ltd
PO Box 162 Birmingham B4 7XD England
Ph: 44 121 380 0100 Fax 44 121 359 3313
Website: www.microponents.com

Toslink Optical Gear from Microgram

With Toslink (digital optical data transfer) becoming more and more popular in many sound cards, DVD players and other digital audio equipment, Microgram Computers have added a range of Toslink equipment to assist users who want to take advantage of the high performance of this relatively new standard.



First are a pair of converters which transform wired (RCA) signals to Toslink or vice versa. Both are priced at $89.00; the 23006-7 converter goes from Toslink to RCA while the 23005-7 goes from RCA to Toslink.

Next is a Toslink Switch Box (23000-7) which avoids wear and tear on optical connections. It has 3 switchable inputs and one output and sells for $54.00

A little more up-market is the plugpack-powered, 4 in, 2 out digital optical (Toslink) switch box with remote control.

It's in a very "showy" plastic case and it retails for $149.00 (23002-7). More info on all the Toslink gear from the Microgram website.

Contact:
Microgram Computers
Unit 1, 14 Bon Mace Close,
Berkeley Vale NSW 2261
Ph: (02) 4389 8444 Fax: 1800 625 777
website: www.mgram.com.au

New low-cost, tiny UHF handhelds from Jaycar

Back in April last year, we looked at the range of small hand-held two-way radios then available.

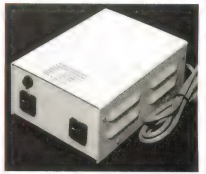
Jaycar has released a new one which could have given our top choice a run for its money: these "Digitalk" tiny (105 x 60 x 25mm) hand-helds operate on the UHF CB band (all 40 channels) and have a range of features which belie their $79.95 pricetag.

All functions are push-button controlled including the "normals" such as volume, channel selection, etc. But they also have such features as channel scanning and call alert, call tone transmitting, VOX (voice activitation) and can also use a vox operated headset/microphone (available separately). There is even a dual time and stopwatch function – very hand for sports use!

They operate from four AAA batteries – alkaline or rechargeable. Jaycar have special volume pricing for quanitities dropping to $63.95 each for 10+

Contact:
Jaycar Electronics
100 Silverwater Rd, Silverwater 2128
Ph: (02) 9741 8555 Fax (02) 9741 8500
Website: www.jaycar.com.au

STEPDOWN TRANSFORMERS
60VA to 3KVA encased toroids



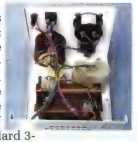
Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

Stabivolt adjustable AC voltage regulator

Some readers will be familiar with AC voltage regulators which use a large transformer and a ferro-resonant circuit to maintain a constant 240VAC.

These are commonly used where AC supplies tend to fluctuate over a wide range or have problems with transient spike voltages.

The Stabivolt is also an AC voltage regulator but it has the advantage that its output is adjustable via a front panel Variac control. Four different models are available without outputs of 2.5A, 5A, 8A and 10A. Besides the front panel Variac, the Stabivolt has a 0-300V voltmeter and a standard 3-pin flush-mount output socket, power switch and fuse.



Line regulation is quoted as being within 1% for mains input voltage variations from -20% to +10% of 240VAC. Output load regulation is not quoted. The output voltage is sinusoidal with typically 3% harmonic distortion.

The output can be set anywhere from 0V to 270VAC.

Since the Stabivolt does use a conventional ferro-resonant isolating transformer, it provides full isolation between the input and output, unlike a standard Variac.

Contact:
Sydney Transformer Co
95c Seven Hills Rd,
Baulkham Hills NSW 2153
Ph: (02) 9620 8356 Fax (02) 9624 1779

Low-cost surveillance system with bonus TV set.

Another one of those surplus bargains from Oatley Electronics is this low-cost surveillance system – with a TV set included for good measure.

The heart of the system is a Panasonic TC-14S15A 34cm remote-controlled colour TV set. These have a pedigree: they were actually used in many venues during the 2000 Sydney Olympic games. (The one you get might have been used by a gold medal winner in the athlete's village!).

Because of their previous use, they may have many channels locked out or be set to "hotel mode" where sound levels are limited and many user controls are unavailable. But these are easy to reset or overcome using the remote control (details are on Oatley's website).

All the TVs have audio/video inputs and outputs as well as the usual antenna intput and would normally be very keenly priced (for a brand-name set) at Oatley's selling price of $295.00

But wait, there's more! Included with every set is a miniature CMOS video camera, complete with its own tiny microphone, which makes a perfect surveillance system when coupled with the Panasonic TV. A small 12V plugpack supply is also included to power the camera.

So if you're looking for a low-cost surveillance system, this is well worth a second glance.

Contact:
Oatley Electronics
Ph: (02) 9584 3563 Fax: (02) 9584 3561
website: www.oatleyelectronics.com

Hong Kong to host largest trade fair in Asia

Following its record-breaking success last year, the Hong Kong Electronics Fair 2002 will be held from October 11-14, 2002 at the Hong Kong Convention and Exhibition Centre.

One of the world's biggest exporters of electronics goods, Hong Kong's exports in this category totalled US$69.017 billion in 2001.

Last year, 1,632 exhibitors from 21 countries and regions converged on the territory to show the latest audio-visual products, electronic accessories, electronic gaming, home appliances, multimedia devices, office automation and equipment, telecommunications products and security products. Group pavilions from the Chinese mainland, Korea and Taiwan provided extra interest. The Fair also drew 42,617 visitors from 133 countries and regions.

Organisers expect that even more exhibitors will be on hand this year. An AC Nielsen survey conducted during the 2001 Fair spotlighted the following product trends and market outlook:

- Entertainment/home appliances and electronics/electrical products for teenagers were identified as the fastest growing product categories over the next year.
- 54% of the exhibitors and 57% of the buyers interviewed predicted a market outlook in 2002 that was the same or better than 2001.

Special events at the Fair that are designed to inform and enlighten include: Frontiers of Brainpower, a showcase for innovative ideas and prototypes from Hong Kong universities and research institutions, which have the potential to be developed commercially.

Seminars and forums for the industry addressed by leading international speakers, with the focus on electrical appliances and consumer electronics.

Two other Fairs being run concurrently with the Hong Kong Electronics Fair are the Hong Kong International Lighting Fair – an important regional event for lighting products and fixtures with 20,000 visitors attending last year and "electronicAsia" – a must-see for electronics components, assemblies, electronics production and display technologies.

A unique feature of the Hong Kong fair will be the Dragon Lounge - a place where visitors can snack, read newspapers and work on-line at a bank of computers. Cathay Pacific Business and First Class passengers are offered free access to the Dragon Lounge at the Fair. To enjoy the facilities within the lounge, passengers simply need to show their boarding passes at the entrance. In addition, the Yum Sing card - entitles you to a wide range of discounts and special offers at many of Hong Kong's top restaurants, bars, shops and more! Simply retain your Cathay Pacific boarding pass and present it to the TDC Fair Management Office during the fair opening to pick up the card.

Australasian companies are also entitled to this special privilege as part of the Buying Mission.

The Fair's Cyber Booking Service allows visitors to pre-schedule appointments with exhibitors on-line. Simply log onto the Fair website and browse through the list of exhibitors by name, product category, country/region.

Log onto http://hkelectronicsfair.com before 20th September 2002 to register for your free admission badge.

You can also enter a series of lucky draws online to win prizes which including free admission tickets to Ocean Park and a free tour to Shenzhen, China.

Contact:
Kitty Mak
Hong Kong Trade Development Council
Ph: (02) 9261 8911 Fax (02) 9261 8966
email: kitty.mak@tdc.org.hk

$2000 For Best Student Exporter

Australian high school students have the opportunity to win $2,000 by entering the inaugural Austrade Export Plan Competition.

The Austrade Export Plan Competition is aimed at helping secondary students learn more about selling goods and services overseas. The national winner will receive $2000 and a trip to Melbourne to attend the prestigious Australian Export Awards presentation dinner in November.

The launch of the competition coincides with the release of new Austrade teaching resources about exporting, which are now available to all Australian high school teachers.

Austrade's Education Program Manager, Leigh Derigo, said the contest was a fun and rewarding way for students to learn more about doing business overseas and explore the export potential in their local area. **SC**

Contact:
Austrade
Ph: (02) 9390 2077 Fax: (02) 9390 2341
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Driving light/accessories protector for cars

This simple alarm can be used to protect powered car accessories (such as driving lights) from theft. It's self-arming, uses just a handful of parts and can be easily integrated with existing car alarms. Alternatively, it can be used as a standalone unit with its own 12V siren.

By RICK WALTERS

One night recently, an acquaintance had a pair of quite expensive driving lights stolen from the front of his 4-wheel drive while it was parked in his driveway. For the thief, it was almost too easy – just unplug (or cut) the leads, undo a couple of mounting nuts with a shifting spanner and off you go. It's that quick!

This circuit is designed to protect your expensive driving lights and at the same time, give the prospective thief quite a scare. As soon as the power lead to the light is cut or disconnected, either the car alarm will be set off or, if you don't have an alarm, a very loud siren will be triggered. If that doesn't scare the "low-life" away, nothing will.

One important feature of this unit is that it's automatically armed each time you turn the ignition off. After all, a thief detector isn't much use if you forget to turn it on. Similarly, the unit is automatically disarmed when the ignition is switched on.

Of course, this also means that the unit isn't foolproof – if a thief "hot-wires" the car, the alarm won't sound but then you'd have much bigger problems than just a pair of stolen driving lights.

How it works

Fig.1 shows the circuit details. As you can see, there is very little to it. The most complicated part is the circuitry involving IC1, which is used to mute the alarm after a short time to comply with noise pollution laws.

We have provided protection for up to four lights and these are connected to diodes D1-D4 via connector CON1. Basically, D1-D4 function as an OR gate. Normally, their anodes (A) are pulled low by their respective driving light filaments and so their commoned cathodes (K) are also pulled low via an associated 100kΩ resistor.

As a result, transistor Q1's base is also low and so this transistor and relay RLY1 are off.

Now consider the situation if one of the driving lights is disconnected. When that happens, the anode of the corresponding diode in the OR gate is pulled to +12V via a 10kΩ resistor which means that the diode is now forward biased. As a result, the commoned cathodes are pulled to about +11.4V and so Q1 now turns on (assuming that Q2 is also on) and activates relay RLY1.

Relay RLY1 is a double-pole double throw (DPDT) unit. As shown, its normally open (NO) contacts are connected to pins 2 & 7 of CON2. When the relay is activated, pin 2 is switched to +12V while pin 7 is pulled to ground. These outputs can be used to trigger the high-going or low-going inputs of an existing car alarm.

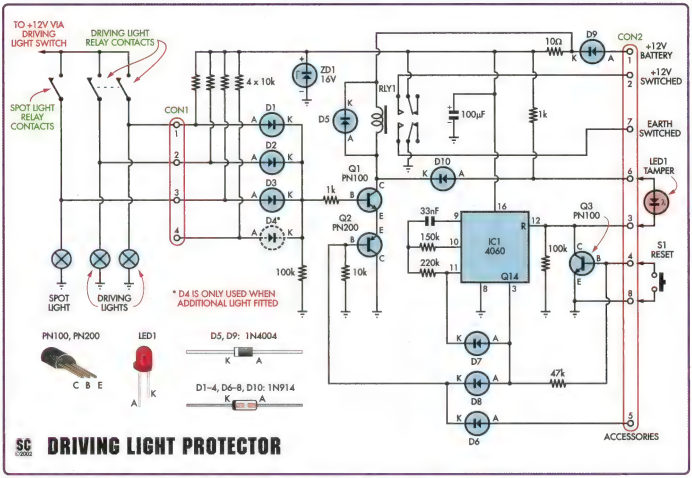


Fig.1: the circuit uses diode OR gate D1-D4 to drive transistor Q1, which in turn drives a relay (RLY1). IC1 functions as a timer and this automatically shuts the alarm off after 90 seconds by turning off Q2.

Alternatively, an external 12V siren can be connected between pins 2 & 7 of CON2 (or connected between pin 2 and ground).

Transistor Q2 (a PNP type) is included to ensure that the alarm remains off while the vehicle is being driven. As shown, this transistor is connected in series between Q1's emitter and ground. Normally, Q2's base is pulled low via a 10kΩ resistor and so this transistor is biased on.

However, when the engine is started, Q2's base is pulled high via the accessories line (pin 5 of CON2) and diode D6. This turns Q2 off and so Q1 and RLY1 are also off and the alarm is disabled. Turning off the ignition then automatically "arms" the circuit again.

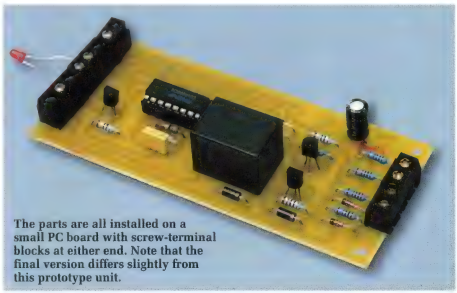
Note that if Q2 were not included, the alarm would sound each time the driving lights were turned on.

Alarm timeout

IC1, a 14-stage binary counter, provides the timeout function. Normally, pin 12 (Reset) of this IC is held high via LED 1 and the 1kΩ resistor to the +12V rail. As a result, IC1 is held in the reset condition and its operation is inhibited.

When the alarm is triggered, Q1 and Q2 are both on and so Q1's collector is pulled down close to 0V (ie, ground). This in turn pulls the anode of LED1 low via diode D10, thus releasing the high on IC1's reset pin. Instead, the reset pin is now pulled down to 0V via a 100kΩ resistor and so IC1 now begins operating.

The RC network on pins 9 & 10 sets the frequency of the internal oscillator, while the selected binary output determines the alarm period. In this



The parts are all installed on a small PC board with screw-terminal blocks at either end. Note that the final version differs slightly from this prototype unit.

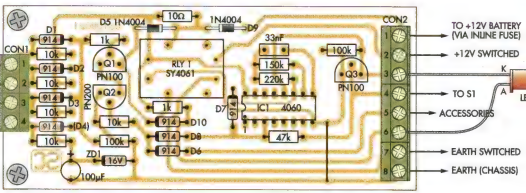


Fig.2: follow this diagram carefully when installing the parts on the PC board. Note that you must only fit as many input diodes (D1-D4) as you have lights to protect; eg, if you just have two driving lights, fit diodes D1-D2 only.

case, we have used the Q14 output at pin 3, which means that IC1 divides by 2^{14} (ie, 16,384).

Since we want the alarm to operate for about 90 seconds, this means that the oscillator frequency should be 16,384/90 = 182Hz. This frequency is set by the 33nF capacitor and 150kΩ resistor on pins 9 & 10.

At the end of the 90s timing period, pin 3 (Q14) of IC1 goes high and this pulls Q2's base high via D8. As a result, Q2, Q1 and relay RLY1 all turn off and the alarm stops.

But that's not all the high Q14 output does – three other events also take place. First, it turns on transistor Q3 via a 47kΩ resistor and this holds IC1's Reset (pin 12) low. Second, it pulls pin 11 high via D7, which stops the oscillator. And third, because Q3 is on, LED1 lights to show that the alarm has been activated – ie, LED1 functions as a "tamper" indicator.

When the wiring to the light has been reconnected, Q3 is turned off by pressing the Reset switch (S1). This releases the low on pin 12 and rearms the circuit.

Power for the circuit is derived from the car's battery (via a 1A in-line fuse – see construction). Diode D9 provides reverse polarity protection, while a 10Ω resistor and 100µF electrolytic capacitor provide supply decoupling. In addition, zener diode ZD1 is included to protect the IC from high-voltage spikes on the supply line (eg, when other equipment switches on and off).

Finally, diode D5 protects transistor Q1 by quenching the back EMF generated each time the relay switches off.

Building it

Building it is easy since all the parts are mounted on a PC board measuring 109 x 48mm (code 03109021). Fig.2 shows the parts layout.

Begin by carefully checking your etched PC board against the published pattern (Fig.3). That done, install the wire link, followed by the resistors, zener diode ZD1 and diodes D1-D10. Make sure that the diodes are all correctly oriented.

Note that we have shown diode D4 dotted on both the circuit and the overlay. This diode should be left out

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Parts List

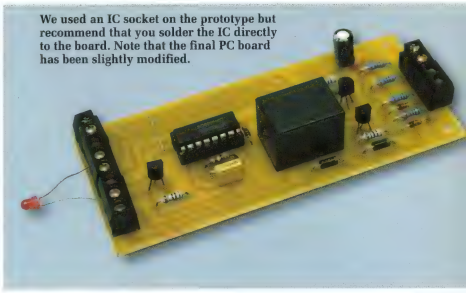
1 PC board, code 03109021, 109mm x 48mm
1 DPDT mini PC-mount relay, Jaycar SY4061 (or equivalent)
3 2-way PC-mount screw terminal blocks (5mm pin spacing)
2 3-way PC-mount screw terminal blocks (5mm pin spacing)
1 pushbutton switch (S1) to suit

Semiconductors
1 4060 14-stage binary counter/divider (IC1)
2 PN100 NPN transistors (Q1,Q3)
1 PN200 PNP transistor (Q2)
1 red LED (LED1)
8 1N914 small signal diodes (D1-D4,D6-8,D10)
2 1N4004 1A diodes (D5,D9)
1 1N4745 16V 1W zener diode (ZD1)

Capacitors
1 100µF 25VW PC electrolytic
1 33nF MKT polyester

Resistors (0.25W, 1%)

1 220kΩ	5 10kΩ
1 150kΩ	2 1kΩ
2 100kΩ	1 10Ω
1 47kΩ	



We used an IC socket on the prototype but recommend that you solder the IC directly to the board. Note that the final PC board has been slightly modified.

unless you have a fourth driving light (or spot light) to connect to pin 4 of CON1. Similarly, diode D3 should be omitted if you don't have a spot light.

In most cases, there will only be two driving lights to protect, so only diodes D1 and D2 should be fitted. In short, only fit as many input diodes as you have lights to protect – ie, if you have two driving lights, fit only diodes D1-D2. If you have diodes connected to unused inputs, the circuit will false alarm.

The remaining parts can now be installed on the PC board. These include the 33nF and 100µF capacitors, transistors Q1-Q3, the screw terminal connectors, IC1 and the relay. Make sure that IC1 is installed with pin 1 adjacent to D7 and note that transistor Q2 in a PN200 PNP type.

Testing

Testing is best carried out on the workbench. First, link the active input terminals on CON1 together (ie, those with diodes) and run a wire to pin 8 of CON2. That done, connect the tamper LED (LED1) as shown in Fig.2, then connect a 12V power supply to CON2 (positive to pin 1, negative to pin 8).

Initially, nothing should happen and the current drawn should be only a couple of milliamps. Now cut the wire between the input terminals to ground, to simulate an attempted theft. You should immediately hear the relay click in and then, after about 90 seconds, it should drop out and the LED should illuminate.

Of course, if you had connected a siren between pins 2 and 8 of CON2, it would have sounded for 90 seconds. However, it's unlikely you would wish to experience this pleasure!

Troubleshooting

The most likely reason for it not to work is that LED1 has been installed backwards. Other likely possibilities include poor or missed solder joints, solder bridges (especially between the IC pins) and parts installed with incorrect polarity.

Having a diode connected to an unused input on CON1 will also cause problems.

Installation

Once the circuit is working correctly, it can be installed in the vehicle. And that's easier said than done because, depending on where the driving light relay is mounted, you may have to run some leads through the firewall.

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	220kΩ	red red yellow brown	red red black orange brown
❑	1	150kΩ	brown green yellow brown	brown green black orange brown
❑	2	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	5	10kΩ	brown black orange brown	brown black black red brown
❑	2	1kΩ	brown black red brown	brown black black brown brown
❑	1	10Ω	brown black black brown	brown black black gold brown

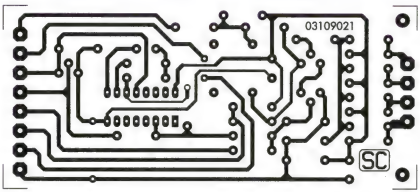


Fig.3: this is the full-size etching pattern for the PC board. Check your board by comparing it with this pattern before installing any of the parts.

Generally, the best place to mount the unit will be close to the fusebox/relay box. This will enable you to easily pick up power and run the input leads to the driving light relay contacts.

We'll leave it up to you as to how the board is protected. Typically, it could be wrapped in foam rubber and secured with cable ties. Alternatively, the board will fit inside a standard 130 x 70 x 40 plastic case, which is available from most suppliers. The tamper LED and Reset switch should be mounted in an accessible location on the dashboard and connected to CON2 via flying leads.

Pin 1 of CON2 must connect to an unswitched battery positive terminal. An unused position on the fusebox is a good place to pick up this connection but be sure to fit a 1A in-line fuse. In most cases, it will be just a matter of buying a fuse to suit your car's fusebox. Note that all connections should be run using automotive cable and connectors.

The car radio supply line is a good place to pick up the accessories feed. Again, this can be picked up at the fusebox.

Driving light connections

If the driving-light relay has double-pole contacts (ie, one set of contacts for each driving light), the leads from CON1 can be wired directly to the relay. Just be sure to connect each input to the driving light side of its contact.

However, if the driving light relay only has a single pole, you cannot wire CON1 to the relay contacts. That's because cutting the leads to one light would still leave a circuit back through the commoned relay contact and the remaining light – and that's just what we don't want.

There is a way around this however, and that's to run the leads from CON1 directly to the driving lights themselves. In fact, you have to make the connection to each light inside the lamp housing itself (so that the thief has to cut the wire). It really doesn't matter which side of the lamp filament you connect to – either side will do.

How can you tell whether or not the driving light relay is a single-pole or double-pole type? Simple, with the power off, disconnect one of the driving light leads from the relay, then check the resistance between its relay terminal and earth.

If the reading is open-circuit, the relay is a double-pole type. Conversely, if you get a reading of just a few ohms, it means that there is a path back through the other driving light and so the relay is a single-pole type.

Siren

In order for the unit to trigger an existing car alarm, you will need to connect one of the switched outputs to an appropriate alarm input terminal – ie, either connect the +12V Switched output to a high-going input trigger terminal, or the Earth Switched output to a low-going trigger terminal.

For example, if you car's alarm is triggered when a door opens and the courtesy light switch is in the ground circuit, then the Earth Switched output can be connected across this switch.

Alternatively, you can use a separate 12V DC siren. If you fit this behind the grille close to the items you are protecting, it should frighten daylight out of any thief.

Finally, note that this circuit will also sound as soon as you turn the engine off if the filament in one of the lamps "blows" – ie, it can also function as a "blown filament indicator". Of course, that's assuming that you have wired CON1 so that the lamp filaments are in-circuit.

However, this feature will be disabled if you connect to the "earthy" side of the lamp filaments inside the lamp housing. **SC**

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

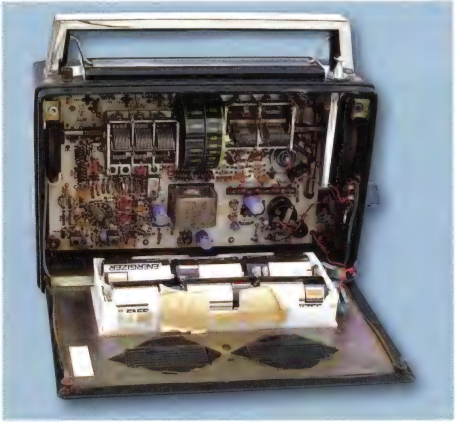
The Barlow Wadley XCR-30 MkII communications receiver

Developed during the 1960s, the Barlow-Wadley Loop principle gave rise to a new generation of up-market communications receivers. Here's a look at one such set and how it operated.

The Barlow Wadley XCR-30 multi-band receiver was made by the Barlows Manufacturing Company Ltd in the Republic of South Africa between 1969 and 1981. The model number "XCR-30" indicated that it was a "crystal-controlled receiver with 30 bands".

This was a relatively rare receiver in Australia, despite the fact that about 20,000 of them were produced. The reason for this is quite simple: Australia (and many other nations) boycotted products from South Africa during that period due to the latter's apartheid policies. However, some of these advanced receivers did make it to Australia and I was fortunate enough to obtain one for personal use (I used them in my work as well).

They were not cheap, selling for around $225 in 1975. The first model arrived in late 1970 and subsequent upgrades occurred until at least 1974. I believe that an FM converter was also made to work with the receiver but I've never seen one of these.



This rear view of the XCR-30 receiver shows how the back is hinged down so that the batteries can be replaced.

At first glance, the set appears to be just another large multi-band portable receiver with a telescopic whip antenna. This is true, of course, but on closer inspection it becomes evident that the set is more than just a multi-band transistorised portable radio. It has a total of 31 bands and tunes from 500kHz to 31MHz in 1MHz segments. And it has the ability to tune AM, single sideband (SSB) and Morse code (CW) signals.

Furthermore, its dial calibrations are quite accurate and it is an extremely stable receiver which exhibits only very slight drifts in the tuned frequency, even at 30 MHz. This means that you can tune to a frequency up around 30MHz and be confident that an AM station on that frequency will be heard as soon as it commences transmission, without the need for retuning. It is not quite as stable as this on SSB, however.

Construction

The set itself is mounted in a steel case which provides reasonable shielding for the electronic circuitry. This case measures 292mm wide by 190mm high by 98mm deep and is

covered with black vinyl over foam plastic sheeting. It also weighs in at just over 4kg with batteries, so it's hardly a "lightweight".

The physical appearance of the set puts it somewhere between a domestic entertainment portable and a professional receiver. And realistically, that is what the set's market segment is – sub-professional.

Sensibly, the manufacturers provided a decent-sized source of power in the form of a pack of six D-cells. The set can also be used with an external 6-12VDC power supply via a 2.5mm DC socket. This was then regulated to around 6.5V in most instances, with the set protected against reverse polarity by a germanium diode.

Strangely, the set has a positive earth which means that it cannot easily be used with a supply with a negative earth, as in most vehicles. Most of the transistors in the radio are NPN silicon types, with just a sprinkling of germanium PNP types, so you would think that a negative earth would have been used.

A 3.5mm miniature phone socket is mounted alongside the power socket and this can drive either an external speaker or headphones. The antenna used for all frequencies is an 870mm-long telescopic whip.

An interesting feature is the use of electronic band changing, thus eliminating the need for a very complex 31-position mechanical switch. To tune the set, the lefthand dial (bandswitch if you like) is set to the particular Megahertz range required and the righthand dial is then rotated until the desired station is heard. For example, Radio Australia on 9580kHz would be tuned by setting the MHz dial to "9", then the kHz dial to "550", then three more small divisions further up the dial brings the set to 9580kHz.

Even if the transmitter wasn't operating at that time, the station would be heard as soon as it commenced operation. How many portables of the early 1970s could boast that degree of tuning accuracy?

The other controls are more conventional. The on-off-volume control is quite conventional, for example. An antenna tune control was a feature of a number of portable receivers (particularly imported multi-band types) and this Barlow Wadley receiver has one too. However, it tunes from 0.5-30MHz in one sweep of the control. The control is either rotated to obtain the best quality signal or if there is no signal, is peaked on the background noise.

The Barlow Wadley XCR-30 multi-band receiver is a good performer. This set is relatively rare in Australia.

As mentioned earlier, the set is multi-mode, being able to resolve SSB and CW signals in addition to AM. As a result, a mode switch is included on the front panel. Its left position selects upper sideband, the centre position AM and the right position lower sideband. In the sideband positions, Morse code (CW) can also be resolved.

Tuning SSB signal is quite critical so the knob above the mode switch is an SSB clarifier. This latter control is used to accurately tune SSB for clear reception.

Performance

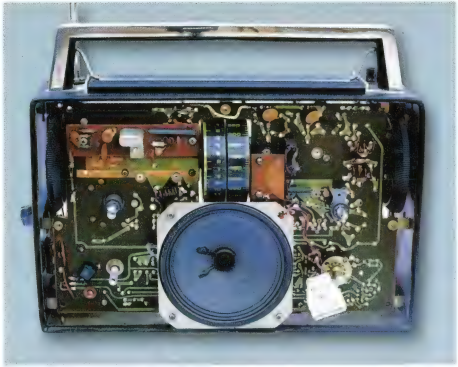
Because it is so different from anything else of the era, it is interesting to see how this rather sophisticated receiver works.

The six D-cell batteries are fitted by first undoing two screws on the top edge of the back using a screwdriver or a small coin. The back can then be laid down, after which the cells can be inserted into the holder. Note that the back can also be completely removed by lifting it out of the gutter at the bottom of the cabinet, while the battery connections can be removed from the battery holder.

Once the antenna has been fully extended, the broadcast band is a good place to start our check on the performance of the set. Let's say that we want to tune to 693kHz. First, the set is turned on and the volume control rotated part way. The antenna trim (tuning) is then set to approximately the position where 693kHz would be (this is a vague setting).

Next, the megahertz dial is set at "0" and the kilohertz dial is rotated until it is just below "700". The mode switch should be in the AM position. If the station is within range, it should now be heard.

It is then necessary to peak the "Antenna Trim" and adjust the MHz and



This view shows the front of the receiver with the front panel removed. The 1MHz crystal oscillator is shown at the top left of the photograph.

kHz dials for best reception. The small signal-strength level meter, just to the left of the frequency setting dials, gives an idea of the relative strength of received signals. Once it's tuned, you can adjust the volume control to the desired level.

Although a bog-standard transistor set may perform well on 693kHz, the Barlow Wadley is a bit disappointing at this end of the dial. However, the higher the frequency tuned, the better the receiver performs. In fact, its performance is sparkling in the higher shortwave regions and it will outperform most receivers of the era on its whip antenna.

What's more, it doesn't drift off station and has good dial calibration. Even on SSB stations, it will remain in tune for considerable periods of time. The audio quality is also good and with around 400mW into its 100mm speaker, the volume is adequate for most situations.

Another feature of the set is the provision of separate antenna and earth terminals. These can be used to improve the reception at low frequencies and the use of an external antenna does help in this regard. However, I was still not satisfied with the performance, so I modified the antenna circuit to improve the reception. We'll take a look at this modification later.

Restoring the XCR-30

Not surprisingly, the cabinet on my set has suffered a few blemishes over the years but is otherwise intact. The grille also has a number of marks and I'm not sure whether I can remove them without doing further damage.

Internally, the set is well protected and damage is unlikely unless it is run over by a truck! Removing the rear panel gives access to a double-sided PC board of quite high quality. This board carries all the circuitry and has the component numbers marked on it, as well as five test points. However, without the service manual, identifying what does what is quite difficult, as this is not a conventional superhet receiver.

To really get serious about servicing this receiver, it is necessary to remove the front panel. First, the knobs are removed, followed by nine screws through the PC board. This allows the front panel to come away and you now have access to both sides of the board, which is great for servicing.

Speaking of servicing, these receivers have a common fault in the VHF sections of the circuit. This is due to the fact that quite heavy enamelled-copper wire is used for the coils and transformers (this was done to maintain alignment stability and to ensure a stable tuning range for the VHF oscillator). However, because these parts are so heavy, they tend to break the solder joints and tracks on the back of the board.

As a result, it's a good idea to resolder these areas of the board, as this seems to fix most problems.

How it works

As already mentioned, this receiver isn't a conventional superhet, so let's see how it works.

At the antenna input, the signal is coupled via a low-value capacitor to the top of one of three antenna coils. These three coils are switched in or out of circuit by two microswitches and are tuned by a ferrite slug attached to the dial cord. As the dial cord moves, this ferrite slug is slid through each of the coils in turn, the proximity of the slug also triggering the relevant microswitch.

This nifty idea means that the antenna can be peaked anywhere between 500kHz and 31MHz with just one sweep of the antenna trim control. The tuned signal is then amplified and applied to a diode balanced mixer (converter), where it is mixed with the VHF local oscillator signal (tuning range 45.5-75.5MHz) to give an output at 45MHz ± 650kHz. This is then applied to a 45MHz broadband IF amplifier.

This high first IF (intermediate frequency) permits the use of relatively simple RF circuitry in the front-end while still achieving very good image response (and there's no complicated 31-position band switching). With a 13.7MHz input signal (MHz dial set to "13" and the kHz dial set to "700"), the image is at 103.3MHz. The 13.7MHz signal beats with a 58.5MHz local oscillator signal, giving an output on 44.8MHz.

Note that the 45MHz IF channel is quite broad in response and will ac-

Fig.1 (right): this is the full circuit diagram for the Barlow Wadley XCR-30 MkII communications receiver. It has a no less than 31 bands, tunes from 500kHz to 31MHz in 1MHz segments and can receive AM, single sideband (SSB) and Morse code (CW) signals.

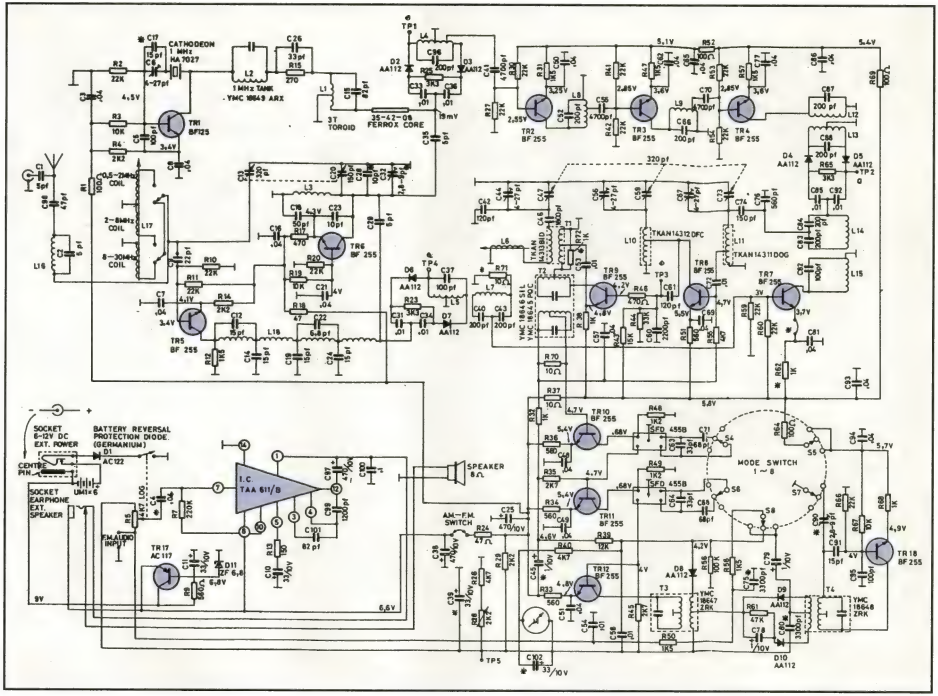

CATHODEON
1 MHz
HA 7027
1 MHz TANK
- YMC 18643 ARX
3T
TOROID
25-4.2-0S
FERROX CORE
TRI BF125
TR2 BF 255
TR3 BF 255
TR4 BF 255
TR5 BF 255
TR6 BF 255
TR7 BF 255
TR8 BF 255
TR9 BF 255
TR10 BF 255
TR11 BF 255
TR12 BF 255
TR17 AC 117
TR18 BF 255
TKAN14312DFC
TKAN14311DOG
YMC 18646 SIL
YMC 18645 ARC
I.C. TAA 611/B
SOCKET 6-12V DC EXT. POWER
CENTRE PIN
SOCKET EARPHONE EXT. SPEAKER
BATTERY REVERSAL PROTECTION DIODE. (GERMANIUM)
AC 122
SPEAKER 8Ω
AM-FM SWITCH
MODE SWITCH 1 - 8
FM AUDIO INPUT
9V
6,6V
5,1V
5,4V
4,5V
3,4V
3,6V
4,7V
5,6V
4,9V
320 pF

Photo Gallery: Airzone Models 529 & 511

The Airzone Model 529: this was an AC/DC broadcast-band receiver with the following valve line-up: EK2 converter, CF2 RF amplifier, CBC1 detector/audio, CL2 output, CY2 rectifier and C1 ballast. (Photo courtesy Bill Adams, VK3ZWO).

The Airzone Model 511: this AC broadcast-band model featured a circular dial and carried the following valves: 6A8 converter, 6K7 RF amplifier, 6Q7 detector/audio, 6F6 output and 5Z4 rectifier. (Photo courtesy Bill Adams, VK3ZWO).

cept signals from around 44.35MHz to 45.65MHz (1.3MHz bandwidth) with little attenuation.

Next, the 44.8MHz signal is amplified and applied to another diode balanced mixer on 42.5MHz. This produces an output on 2.3MHz (44.8MHz - 42.5MHz = 2.3MHz). An image of the 44.8MHz signal would occur at 40.2MHz but will be insignificant due to the selectivity of the 45MHz IF amplifier and the very high frequency of the image response at the first mixer.

The signals at the input of the 2-3MHz tuneable second IF amplifier cover a whole megahertz, so it is necessary to tune this stage to 2.3MHz. This section of the receiver can be considered quite standard. In this particular scenario, all the signals in the range 13-14MHz can be selected as desired by the tuneable IF (kHz dial).

However, it is possible to have breakthrough of an image signal which is located 910kHz (ie, twice the IF frequency) higher than the wanted signal. Thus, a signal on 2050kHz will have an image at 2050 + 910 = 2960kHz. To overcome this problem, an RF amplifier stage makes sure that the image is rejected.

The 455kHz amplifier (3rd IF amplifier) is straightforward. It only uses one conventional IF transformer and most of the selectivity is achieved by two ceramic resonators. The signals are then applied to a conventional diode detector for AM signals, or to a product detector for SSB/CW signals.

Finally, the signals are amplified by a conventional audio amplifier. This consists either of discrete transistors or an audio amplifier IC.

Local oscillator stability

Although the VHF oscillator in the receiver is stable, it's certainly not stable enough for SSB (or even AM) reception without the received signal drifting well outside the passband of the IF amplifier.

In a conventional broadcast-band receiver, the local oscillator drifts over time and this may be as much as 5kHz when the oscillator is on 1500kHz (ie, for a tuned frequency of 1045kHz). However, in the Barlow-Wadley receiver, the oscillator for the first mixer may be on 75MHz and if it suffered the same percentage of drift, it would drift 50 times as far – ie, 250kHz. That's not good as it would mean that the dial calibrations would be out and, even worse, just moving the set ever so slightly would completely detune SSB signals.

Fortunately, the drift in the oscillator is noticeably less than this but in a conventional receiver, it would still be too much for listening to AM or SSB without having to regularly adjust the tuning.

So how is the VHF oscillator set up so that it remains exactly on the correct frequency? Well, that's not possible but it is made as stable as practical. Any drift is then corrected for using the "Wadley Loop" principle so

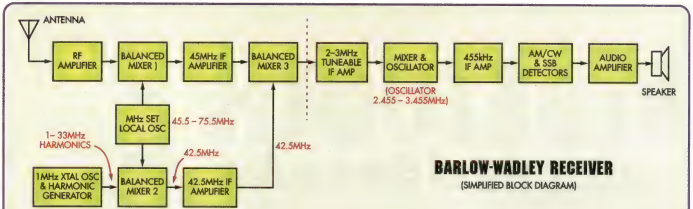


Fig.2: this simplified block diagram will help you understand how the Barlow-Wadley Loop works. Follow it in conjunction with the description given in the text.

let's see how this works.

Fig.2, which is a block diagram of the receiver, will help you understand the basic principle. As shown, a 1MHz crystal oscillator is incorporated into the receiver and its output is processed in an harmonic generator to provide harmonics extending beyond 33MHz. It also sets the 1MHz tuning range for each band.

The VHF local oscillator tunes nominally from 45.5-75.5MHz and whenever its output minus an harmonic of the 1MHz oscillator equals 42.5MHz, a particular band is selected.

For example, if the receiver is tuned to the 13MHz band, the oscillator will be on 58.5MHz. This 58.5MHz is mixed with the 16th harmonic of the 1MHz crystal oscillator in balanced mixer 1. This gives 58.5 - 16 = 42.5MHz which is then fed to a 42.5MHz IF amplifier stage.

Note that this IF amplifier does not amplify the received signal – instead, it amplifies only the 42.5MHz mixing product of the two oscillators. This 42.5MHz "local oscillator" signal then mixes with the band of signals centred on 45MHz in balanced mixer 3 to give signals in the 2-3MHz range as previously explained.

Earlier in the article, an example of a received frequency of 13.7MHz was used. It mixed with 58.5MHz (mixer 2), giving a 44.8MHz output (45MHz IF). This was then mixed with the 42.5MHz signal to give 2.3MHz. This is the case where the VHF oscillator is exactly on 58.5MHz.

But what if the VHF oscillator drifts to 58.6MHz? The signal in the 45MHz IF will now be on 44.9MHz and if mixed with 42.5MHz, the tuneable IF stage would need to be reset to 2.4MHz. And that's quite unsatisfactory, as this would mean that the kHz dial would have to be retuned.

However, all is not lost. The 58.6MHz signal is mixed with the 16MHz signal from the crystal oscillator and gives an output of 42.6MHz which is still within the passband of the 42.5MHz IF amplifier. This 42.6MHz signal is then mixed with the 44.9MHz IF signal (mixer 3) and this gives an output of 2.3MHz.

This is exactly the same as when the VHF oscillator was on 58.5MHz. So even though the oscillator has drifted 100kHz, the Wadley loop system has cancelled this drift out. The VHF oscillator can therefore drift ±150kHz (the acceptance bandwidth of the 42.5MHz IF amplifier) and the front end of the receiver will still have crystal-locked frequency stability!

All in all, it's a very nifty way of cancelling the VHF oscillator drift.

Improving sensitivity

Because I was dissatisfied with the sensitivity of the receiver at low frequencies, I decided to install conventional primary windings over the aerial coils. First, some 20 turns of 36-40 gauge enamelled copper wire was wound at the earthy end of the 0.5-2MHz aerial coil. One end of this coil was soldered to the nearby PC board earth and the other to a 3-position single-pole switch mounted near the headphone socket.

The 2-8MHz coil had 7-8 turns wound onto its earthy end and the active wire was also taken to the 3-position switch, while the other end went to the PC board earth, as before. These new primary windings were held in place with a dab of nail polish.

The 8-30MHz coil was directly tapped at the seventh turn from earth and this tap was taken to the third position on the switch. The moving contact of the switch was then connected via a thin coaxial cable to a BNC cable socket mounted near the earth terminal. These simple modifications greatly improved the performance on the lower frequencies. **SC**

BLUETOOTH

Getting rid of the cables

By far, the most common method of connecting computer peripherals is to use cables, although some devices such as keyboards, mouses and mobile phones use infrared (IrDA) technology. Bluetooth is about to change all that and it's got nothing to do with dentistry.

By GREG SWAIN

ALTHOUGH IT MAY sound mysterious, "Bluetooth" is actually the name for a (relatively) new technology that allows PCs, computer peripherals and other devices to be connected using wireless communications. Basically, it's a short-range radio link that's designed to eliminate all those messy cables that are now used to connect keyboards, mouses, printers, modems and the like.

Bluetooth is also intended to render IrDA (infrared communication) obsolete. The problem with IrDA is that it is line-of-sight only, its range is strictly limited and communication can only take place between two devices at any one time. Bluetooth overcomes all these problems and, once set up, is easier to use as well.

In fact, ease of use is touted as one of the big advantages of Bluetooth. The devices automatically find each other (eg, when you bring a laptop in range of a desktop PC), after which the user can carry out a range of tasks, including dial-up networking, faxing, network access, file transfers and information exchange.

Technically, Bluetooth operates in the unlicensed 2.4GHz band and uses frequency-hopping spread-spectrum techniques. This not only helps ensure security (other security measures are built in) but also protects the system from interference. And because RF transmissions are used, communication between two machines is not just limited to line-of-sight.

The actual range depends on the class of the Bluetooth device. Class 1

The BT007 Bluetake USB Dongles (MicroGram Cat. 11904-7) are basically small radio transceivers which plug directly into USB ports. They are Class 1 devices with a range of about 100 metres.

devices have a range of about 100 metres in free space, while Class 2 devices have a range of just 10 metres. That latter figure might not sound like much but it's usually more than enough if the devices are in the same or adjacent rooms.

So how do you get two devices "talking" to each other using Bluetooth? Many devices now come with Bluetooth already built in (eg, mobile phones, printers and stand-alone modems) but in the case of PCs, the answer is to use Bluetooth "USB dongles" or "USB adapters". As the names imply, these are compact radio transceiver modules which directly plug into the USB port of a PC.

What's available

Typical of the gear that's now available is the BT007 "Bluetake USB Dongle", as sold by MicroGram Computers (Cat. 11904-7). This is referred to by MicroGram as a "Bluetooth USB Home LAN – Dual Dongle" and is just the shot for a home network without cables – eg, for connecting a laptop to a desktop PC for file transfer or Internet access.

The package includes two Bluetooth dongles – one for each machine – along with a setup CD and a user guide. Also included are four Velcro sticky pads so that you can secure the dongle to the top of your PC or in some other convenient location. For maximum range, it's best to position the dongles so that they aren't shielded by metalwork.

The dongles in the BT007 package are Class 1 Bluetooth devices (ie, they have a range of about 100 metres) and the maximum data rate is specified as 1Mb/s. This data rate is much slower than for a conventional 10/100Mb/s wired network (Ethernet) but is still adequate for exchanging data in most situations, provided you're not often moving very large files.

The supplied setup software comes on a CD and is compatible with the Win98SE, WinMe, Windows 2000 and Windows XP operating systems (note: neither Windows 98 nor Windows NT support USB). Also on the CD is a free copy of Symantec's WinFax Pro 10.0 plus a trial version of WinRoute Lite which is necessary for internet access under Win98SE/Me. By contrast, Windows 2000/XP rely on Internet Connection Sharing (ICS) for this function (it doesn't work with ICS under Win98SE/Me).

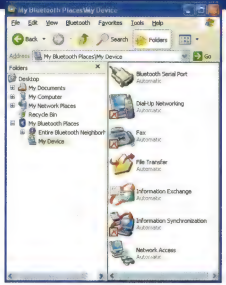


Fig.1: "My Bluetooth Places" lists the various services that are available and works a bit like the familiar "My Network Places".

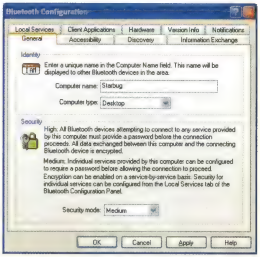


Fig.2: the "Bluetooth Configuration" dialog is accessed via the icon that's placed in the System Tray. Most of the options are self-explanatory.

Getting it up and running is basically a matter of first installing the application software on each machine, then plugging in the dongles into the USB ports. The dongles are then automatically detected and the drivers installed. This also places a new icon in the System tray, along with a shortcut to "My Bluetooth Places" on the desktop.

For network access, one machine must be set up to act as a server. As mentioned above, this involves enabling ICS on a Windows 2000/XP machine or installing WinRoute Lite on a Win98SE/Me machine (this is all described in the User Guide). The other machines then act as clients.

And that's it – your system is now Bluetooth-enabled!

Double clicking the new icon in the System Tray brings up the "Bluetooth Configuration" dialog as shown in Fig.2. You can perform a variety of tasks here, including setting the secu-

The Poke 2th Bluetooth CF Card (MicroGram Cat.11902-7) is a compact flash (CF) card designed for devices running Windows CE. This is Class 2 device with a 10-metre range.

Not much bigger than your thumb, the "Poke 2th" Bluetooth USB Adapter" (MicroGram Cat. 11901-7) also plugs directly into a USB port. This is another Class 2 device (ie, it has a 10-metre range).

rity level, specifying default folders for information exchange, and setting up "pairing" and accessibility. Pairing allows devices to be set up so that you don't have enter access information each time a connection is attempted.

My Bluetooth Places

The "My Bluetooth Places" window dialog works a bit like "My Network Places" on the Windows desktop. It also allows you to enable and disable the various services that are available (see Fig.1). These services include the following:

- Bluetooth Serial Port: establishes a Bluetooth wireless connection between two devices. The connection may be used by an application as though a physical serial cable connected the devices.
- Dial-Up Networking: a Bluetooth client can connect to the Internet via a modem that is physically connected to the Bluetooth server.
- Fax: a Bluetooth client can send a fax via a fax machine that is physically connected to the Bluetooth server.
- File Transfer: when the File Transfer service is established between two Bluetooth devices, you can easily browse, drag/drop, open, print, cut, copy, paste, delete or rename files and folders in local and remote directories.
- Information Exchange: this service allows two Bluetooth-enabled devices to exchange personal information manager data such as business cards, email messages and notes.
- Information Synchronisation: this allows two Bluetooth-enabled devices to synchronise Personal Information Manager data.
- Network Access: this establishes a wireless connection between the client and a server that's physically connected to a Local Area Network (LAN). If the client has permission from the server, the wireless connection can be used as if the client were hardwired to the LAN.

What else is available?

Also available from MicroGram is the "Poke 2th" Bluetooth USB Adapter" (Cat. 11901-7). It's not much bigger than your thumb, plugs directly into the USB port and is a Class 2 device (ie, it has a 10-metre range).

Apart from the smaller range, it works exactly the same as the BT007 dongle described above – even the software is the same.

It is ideal for transferring data between your notebook/PC and a Bluetooth-enabled PDA or mobile phone.

In a similar vein, MicroGram also has the Poke 2th Bluetooth CF Card (Cat.11902-7) – a compact flash (CF) card designed for devices running Windows CE. This is another Class 2 device (10-metre range) and comes with its own application software (on CD ROM) and a comprehensive User Guide.

Price and availability

The following equipment is currently available from MicroGram Computers (all prices include GST):

(1) Bluetake USB Dongle, BT007 (includes two dongles); Cat. 11904-7 – $349.00.

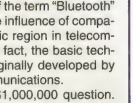
(2) Bluetake USB Dongle, BT007 (single dongle); Cat 11903-7 –$199.00.

(3) Bluetake 2th USB Adapter, BT009S (single adapter); Cat 11901-7 – $149.00.

(4) Bluetake 2th CF Card Type 2, BT100S (single card); Cat 119020-7 – $199.00.

For further information, contact MicroGram Computers, Unit 1, 14 Bon Mace Close, Berkeley Vale, NSW 2261. Phone: (02) 4389 8444. Their email address is sales@mgram.com.au or go to **www.mgram.com.au** **SC**

Why Bluetooth?



Now for the $64,000 question: why is it called "Bluetooth"?

The term comes from Harald Blatand who was a Danish Viking king during the tenth century. Blatand translates into Bluetooth in English and his big claim to fame was that he managed to unite Denmark and part of Norway into a single kingdom – just as Bluetooth is now uniting PC equipment.

Apparently, Harald wasn't the pillaging type of Viking legend. Instead, he introduced Christianity into Denmark but that didn't stop him from coming to a sticky end – he was killed in 986 AD during a battle with his son, who then succeeded him as king!

The choice of the term "Bluetooth" also reflects the influence of companies in the Baltic region in telecommunications. In fact, the basic technology was originally developed by Ericsson Communications.

Finally, the $1,000,000 question. Did Vikings really wear those funny helmets with horns stuck on them? Well, according to numerous websites, they did wear metal helmets to deflect blows to the head during battle but there were no horns on these helmets. It's all the stuff of myth.

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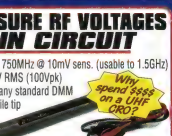

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Substituting a 7406 for a 74LS06

I'm getting started with more complicated PC boards and get both SILICON CHIP and Elektor but since the latter is British I have problems with how to get the ICs they suggest.

So can you suggest a good IC comparison book which would tell me if I can replace the 74LS06 (Low Power) with the 7406 since I can't it at Jaycar or DSE? (S. V., via email).

● In most circuits the 7406 may work instead of the 74LS06. However, if the circuit is running at very high frequencies it may not. You can purchase the 74LS06 from Altronics in Perth and their dealers. See www.altronics.com.au

600W DC-DC converter upgrade

I would like to build the 600W DC-DC Inverter featured in the October 1996 issue of SILICON CHIP to run an amplifier I have built. However, the amplifier requires supplies of ±85V. Could I just change the number of windings on the transformer or do I have to change other things like current sensor etc? (A. S., via email).

● You only need to change the output windings to obtain ±85V. 15 turns on the secondaries should give the required voltage.

The current limit is for the 12V input side of the inverter and limits the current if it exceeds 79A. This should not be altered. It will allow the inverter to deliver the 600W of power to the amplifier.

Speed control for Super-8 projector

I am attempting to transfer my Super-8 movies to video using a digital camera. Unfortunately, I am getting a strobing effect which I think I can correct by altering the speed of my projector motor. The motor is 12V DC and rated at 25A. Is it possible to adapt the 12/24V 20A speed control published in the June 1997 issue, to cater for the additional current. (T. C., Pearl Beach, NSW).

● The projector rating of 25A is probably mainly due to the projector lamp. The motor probably draws less than 1A. If you decide to use a speed control you do not want to vary the voltage to the projector lamp.

Valve radio repairs

I have an old valve radio that I would like to resurrect and don't know who does this kind of repair. I was wondering if you know where I might be able to get it fixed. (G. H., Kensington, NSW).

● We suggest you contact the Historical Radio Society of Australia: http://hrsa.asn.au

Feedback problem in Neon Tube Display

I am experiencing a problem using your Neon Tube Sound Display (SILICON CHIP November 2001), as sold by Jaycar Electronics. When operating at higher volume levels, I am noticing quite a lot of feedback coming from the Neon Tube Sound Display board into my Subwoofers. I have added a 100kΩ potentiometer in series with the input of the kit to stop the feedback. My system is set up as a

Questions about SteamSound Simulator

In October 1991, you published a design for a Steam Sound Simulator (Mk.II), based on an earlier design. I have built such a unit and power it via a conventional voltage controller throttle using the modifications specified in the article. Could you answer three questions? Firstly, can the input to IC1a from the white noise generator be altered to reduce the steam volume as it appears to swamp the chuffing output from the VCO? Or conversely, can the output of the VCO be increased?

Secondly, can the rate of the sawtooth oscillator (Q2) be altered to increase its spread? Currently, with variable resistors for Ra and Rb, the best I can manage is a chuffing range of 3 - 8V (ie, no chuff at 3V and maximum chuff rate at 8V).

Thirdly, how can I remove the motor whine etc from the circuit? A ceramic capacitor of anywhere between 22nF (.022μF) to about 100nF (0.1μF) across the brushes does nothing. The whine swamps the chuff and steam and increases in pitch with motor speed. Interestingly, using the same motor does not produce any problems with the Diesel Sound Generator.

By the way, I have built and used two steam whistle/diesel horns, one as a steam whistle and the other as a diesel horn and they sound really great. The diesel sound generator works really well, although I upped the value of the zener diode to about 15V to increase the frequency spread. (P. S., Brisbane, Qld).

● It is not a question of the steam volume swamping the chuffing output. It is more likely that you have insufficient modulation via D8. The most likely solution is to increase the gain of IC1a by increase the 560kΩ resistor to say, 1MΩ. You then may need to reduce the gain of the following IC1c stage by increasing the 5.6kΩ resistor to 10kΩ.

We do not see any easy way of increasing the chuff range, assuming that you have followed the procedure in the article for selecting Ra & Rb. Motor whine is a problem. If the motor itself is close to the SteamSound PC board there may be nothing you can do since the motor field is inducing noise directly into the PC board. If there is a reasonable space between the two, you may get some improvement by increasing the capacitors associated with the 78L05. Also try connecting a 10μF capacitor across the 4.7V zener diode.

mono system delivering 200W.

The kit initially worked correctly for the first week of operation, however this feedback problem started. Several friends who installed the same kit to their car audio systems have also experienced the same problem. Is there a fix? (M. B., via email).

● We are inclined to think that the interference is due to the pulse currents from the neon tube drivers getting back into the signal line to your amplifier. The usual way to solve this problem is to have separate supply and ground lines going back to the battery rather than relying on common supply lines to your amplifier etc.

Negative ion generator circuit wanted

I am chasing instructions to build a 240V Negative Ion Generator. I was unable to find any mention of one in your kit list on the web site.

I realize they are a string of diodes and capacitors in a succession of voltage doubling circuits but I don't understand the Cockroft- Walton multiplier principle enough to design one myself. I know it would need some final resistors to make the emittor pins safe but the problem is working out where to cutoff the voltage doubling to minimize ozone production.

Can you advise me if you have had a design in an early edition or could you do an article on negative ion generators and the Cockroft-Walton multiplier circuit principle? It has so many other uses it must be of interest to readers. (M. B., via email).

● SILICON CHIP has not described a Negative Ion Generator but one was described in the April 1981 issue of ETI. It did use a Cockroft-Walton multiplier. That issue also had a good information article on Negative Ion Generators. We can supply photostat copies of these articles for $8.80 including postage.

13.8V for car amplifier

I have a few questions concerning the 25A amateur transceiver power supply described in your May & June 1991 issues. Was that a switchmode design? Can it be upgraded to 35A continuous? I'm trying to make use of this car amplifier I've got. The only other recourse I can think of is to bypass the existing power supply, replacing it with a conventional 240VAC supply but so far I have been unable to find a circuit diagram for the amplifier.

Finally, have you ever described a power supply above 25A @ 13.6V? (T. C., via email).

● The 25A power supply used a phase-controlled Triac in the primary of a large transformer and used 2-stage LC filtering in the secondary. So it was switchmode but not in the same way as today's PC power supplies. It is not practical to upgrade the design and we have not produced anything larger.

Any practical 13.8V high current supply will cost far more than your car amplifier is likely to be worth.

Reversing switch not recommended

I have built the 240VAC 10A motor speed controller from the November 1997 issue and it works great. I would like to put a reverse switch in the circuit. Have you got any ideas or circuit programs that I could use to make this happen?

Also, I would like to restrict voltage output to 180V DC so that I can run a 180V DC motor. (W. V., via email).

● The normal way to provide reversing is to use a DPDT (double-pole, double-throw) switch wired as changeover switch. We showed how to wire such a switch in the simple train controller featured in the February 1993 issue. But we strongly recommend against incorporating a reversing switch into the 10A speed controller. If you reverse the motor while it is running you will cause catastrophic failure to the major high voltage components in the circuit.

However, since you mentioned that you are using a 180V DC motor we strongly suspect that it is a universal motor, ie, a series-wound brush motor. If so, then it cannot be reversed, unless you reverse the connections to the field windings.

If you want to limit the output voltage, you will need to limit the range of the speed control pot VR1. As a suggestion, try increasing the 1kΩ resistor in series with VR1 to 10kΩ and the 8.2kΩ to 12kΩ. To confirm these changes, you really need a true-RMS voltmeter.

Incidentally, if you had built our half-wave Drill speed controller published in the September 1992 issue, the output would automatically have been limited to about 170V, suitable for a 180V DC motor.

Protection board has reversed diode

I have just purchased the speaker protection kit for the Ultra LD amplifier (SILICON CHIP, August 2000) from Altronics in Perth. I connected it to a 30V supply. It says to use a 35V-0-35V supply but I only have a 30V toroid.

When I applied power to it, the PC board tracks on the 35V inputs between the solder pin and the two diodes lifted and the diodes started to crack and also the transformer started to make a hum. It's like the diodes are reversed or there is a lot of resistance or something. Could you help me with this? (C. B., via email).

● It sounds as though you have wired one of the diodes the wrong way round. That will blow both diodes and do the damage you describe. The cathodes (white stripe end) of both D1 & D2 should connect together onto the same section of the PC board.

Where is $V_{CC}/2$ in DI box?

I've just bought and built the DI box (SILICON CHIP, August 2001) and I am up to the testing part, where it says to connect the multimeter to pin 6 of IC2 and $V_{CC}/2$, then adjust the VR5 trimpot. So where is $V_{CC}/2$? And what should my multimeter be set to? (A. L., via email).

● $V_{CC}/2$ is half the supply of 9V so it equals +4.5V. It is derived by the voltage divider consisting of two 100kΩ resistors. You can see it on the circuit immediately below diode D3. On the PC board, you can find it on the end of the 27kΩ resistor (not the end which goes to pin 3 of IC2). You will need to set your DMM to its lowest DC range and then adjust trimpot VR5 to the minimum possible voltage (ie, 0V) when measuring between Vcc/2 and pin 6 of IC2.

How increase light dimmer rating

I know that the Touch & Remote control light dimmer (SILICON CHIP, January 2002) is limited to a load of 250W but I was wondering if there is a

way of making it capable of handling a 450W load? (R. B, via email).

● The limit of 250W is set by the Triac's dissipation limit. To increase it requires the addition of heatsink to the Triac. This is not easy to do because of the very confined space on the PC board and the limited amount of space within the wall cavity that the dimmer is installed in.

Switched control for speed circuit

I have built a motor speed control from a circuit published in your June 1997 magazine. I am a novice builder but managed to get the circuit to work as intended and control a 12V motor. I would like to know is if it is possible to replace the 5kΩ speed control pot (VR1) with a bank of resistors of different values that can be switched in and out of the circuit with a rotary switch. This would give a stepped range of speeds for the motor.

I have tried this but can't get the circuit to work properly. (D. C., via email).

● Just get a single-pole 12 position rotary switch and wire eleven 470Ω resistors around it. The wiper of the switch then becomes the wiper of your "switched" pot.

How to eliminate plugpacks

I have been looking in to ways to try and eliminate my bulky power packs for my computer peripherals. I read the article on the PC Powerhouse (SILICON CHIP, December 1999) and found it won't quite do what I need but it is a great concept. I have seven power supplies all up: 4 x 12V, 2 x 9V and one 7.5V, all of which are rated at 1A DC. I am not sure what they are actually drawing but I am sure they are not all 1A each. I would like to be able to cater for additional power packs in the future. As I only have two power points in the room and power boards are useless to try and fit these things on to, I am hoping you might have a better suggestion. (R. A., via email).

● Depending on current drains, you may be able to use one or two 12V DC plugpacks to run all your 12V accessories, then one 9V instead of two 9V plugpacks and so on. That way, you don't build anything but you can eliminate most of the plugpacks.

The only point do you have to watch is to make sure that all the peripherals are negative chassis, ie, the 0V line connects to the earthed metalwork of the peripheral device.

Maximum cable length for water level gauge

What would be the maximum length for the figure-8 cable between the sensor and the display unit in the water level gauge featured in the April 2002 issue of SILICON CHIP? (J. E., Silverwater, NSW).

● This is not something we have checked but it should be OK with cables up to at least 10 metres.

Battery charger with UC3906

I am looking for an article describing a "Sealed Rechargeable Battery Charger". In particular, it uses the UC3906N IC. Could you please advise me which article I am looking for and if I can purchase a reprint from you? (A. B., via email).

● We first featured the UC3906 in July 1989 in an article entitled "Intelligent charger for 12V gel batteries as just a PC board. Later, it was featured in a full-blown charger for 6V/12V batteries, and the data sheets were in March 1990.

Subsequently this charger was substantially revised in August 1992. However, if you want a comprehensive charger which includes SLA batteries we would recommend the Multipurpose fast charger featured in the June & July 2001 issues. We can supply all these issues (except August 1992 - available as a photostat) for $7.70 each, including postage. SC

Notes & Errata

4-channel UHF rolling code receiver, July 2002: the circuit on page 20 has the Set and Reset labelling on the four flipflops swapped over, ie, pin 6 on IC1a should be Set (S) and pin 4 should be Reset (R). In other respects the circuit is correct.

Digital Reverberation unit, December 2000 & January 2001: the output resistor from pin 6 of IC3 is shown as 10kΩ on the PC board diagram on page 73 of the January 2001. It should be 150Ω, as shown on the circuit in the December 2000 issue. Also, the wiring diagram one page 68 of the January 2001 issue has the earth and signal connections reversed on the output of the digital reverb board.

Remote Control Extender, June 1996: this project was previously found to be incompatible with Mitsubishi VCRs.

However a reader has discovered that it can be made to work if the Mitsubishi VCR's remote is used to program an AR-1712 (4-in-1 model) learning remote (available from Jaycar).

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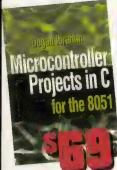

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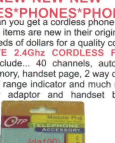

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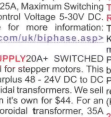

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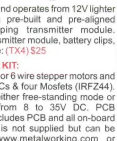

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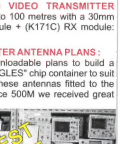

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